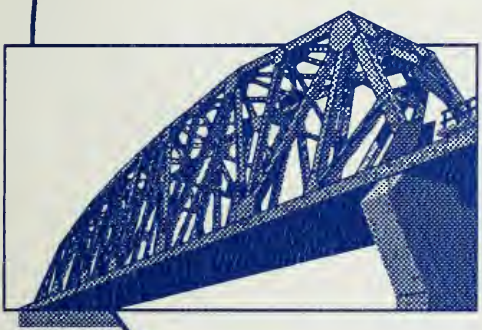
PROCEEDINGS

OF THE

94th ANNUAL CONFERENCE

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION



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Ninety-Fourth Annual Conference

of the

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Association

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IN MEMORIAM

Merwin H. Dick

1907 – 1989

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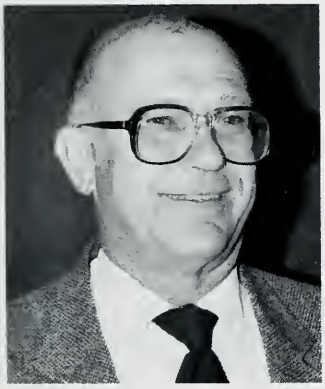

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Official Opening of REMSA '89 by the four association presidents: *Left to right:* R.A. Tallent Jr., D.A. Himes, E.J. Matte, J.R. Clark.

PROCEEDINGS
OPENING JOINT SESSION
Monday, August 28, 1989

President Matte: Good morning ladies and gentlemen. As president of the Roadmasters and Maintenance of Way Association of America and on behalf of Ray Tallent, president of the American Railway Bridge and Building Association, I declare this 101st annual conference of the Roadmasters and Maintenance of Way Association of America and the 94th annual conference of the American Railway Bridge and Building Association to be open and in session.

Foremost in my mind and because of his invaluable contribution to our associations it is with great sadness that I must announce the passing of Merwin Dick, a long standing member of both organizations and a past president of the Bridge and Building Association in 1958-1959. Mr. Dick was very active for many years and I would be remiss if I did not say that his participation will be sorely missed by all.

It is proper that we pause to ask for divine guidance and inspiration before the commencing of our conference. I would like to call on Karl Sutherland to give us a few words of inspiration. Karl, as you know, is a past president of the Roadmasters and Maintenance of Way Association. Karl.

Mr. Sutherland: Shall we all stand please for the Lord's blessing. Father in heaven we have come to you this morning as we open this conference, asking for your guidance and blessings on each one attending. We seek your presence throughout this conference, and may your presence guide, strengthen, and lead all the speakers who will be with us each day, and give them encouragement and confidence during their presentations as we have all come to share our experiences and learn from our peers. May the business of the day be conducted in the spirit of the greatest amongst us. We thank you, Father, for the safe journey to Toronto, and may your watchful care continue over us until we return to our homes. We ask these things in Jesus' name. Amen.

President Matte: Thank you very much, Karl. Our meeting tradition continues, and it is most gratifying to have a former member and past president of the Association lead us in prayer before the start of the conference. I join President Tallent in welcoming you to the first joint session of the two associations. As you can see in the program we have excellent presentations covering many different topics related to railroad engineering and construction. Past practice has been to hold morning meetings only during a show year, and this year there is no change from this practice. This enables us all to have a free afternoon to take in inside and outside exhibits. We sincerely hope you will enjoy your visit to Toronto and urge you to attend the sessions. Enjoy yourselves and partake of the hospitality extended by REMSA.

For the ladies we have interesting programs, starting today with an orientation presentation at 9:30 and a tour of Toronto. Tomorrow we have a sight-seeing cruise of Toronto harbor. The tour will depart at 9:30 with lunch at Ed's Warehouse.

There are a few snags this morning, because all of the transportation that was supposed to be provided for the ladies and for us to the outside exhibits was to be supplied by the TTC, the Toronto Transit Commission. This morning TTC decided to work-to-rule. As railroaders, we know what work-to-rule means so we're not too unfamiliar with it. However, we are trying to come up with some contingency plans. Some of them are working and some we're not too sure of, so we'll have to play it by ear.

At this time I would like to bring you up-to-date on registration: we have a count of 558 Roadmasters, 46 B&B, 448 preregistered, 397 women, for a total of 1,449. Comparing this to our last show year in Dallas, which had a total at this time of 1,755, I think we're doing fairly well. Registration indicates a high level of interest and reflects the faith that our management has in these activities.

I would like at this time to introduce the

officers and directors of the Roadmasters and Maintenance of Way Association who are seated at the head table. Those whose duties demand their presence elsewhere will be introduced at a later session. Your officers are doing an excellent job in directing your association and make the job of the president easy. They are a great bunch of guys. As I introduce each person I ask that he stand and remain standing until all have been introduced. I also ask that you hold your applause until all have been introduced.

Beginning on my left, First Vice President Keith Pottorff, director of maintenance of way system, Atchison, Topeka and Santa Fe Railway, Albuquerque, New Mexico; Second Vice President, Jerome D. Cossel, chief engineer design and construction, Conrail, Philadelphia, Pennsylvania; Immediate Past President, Ray Snyder, assistant chief engineer structures, Chicago and North Western Transportation Company, Chicago, Illinois; Treasurer Stephen J. Hill, assistant regional engineer, Soo Line, Chicago, Illinois; Director Kendall F. Koff, engineer of track systems, Chicago, Missouri and Western, Springfield, Illinois.

Directors: Keith Nordlund, project manager, CN Railway, Toronto; Johnny M. Johnson, manager of maintenance of way training, Atchison, Topeka and Santa Fe Railway, Albuquerque, New Mexico; Hugh J. Fuller, engineer of public projects, CSX Transportation, Jacksonville, Florida; Sam W. Brunner, signal material engineer, Illinois Central Railroad, Chicago, Illinois; Ron F. Poulsen, maintenance engineer work equipment, Union Pacific, Omaha, Nebraska; McKinley Scott, director track maintenance northeast corridor, Amtrak, Philadelphia, Pennsylvania; Eugene D. Schubel, roadmaster, Burlington Northern, Quincy, Illinois; Robert W. Wright, assistant division engineer, Norfolk Southern, St. Louis, Missouri; Alan B. Butler, division engineer, Conrail, Pittsburgh, Pennsylvania; Barry C. Mohl, superintendent maintenance of way , Birmingham Southern, Fairfield, Alabama; and Carl G. Edwards, roadmaster, CSX Transportation, Selma, North Carolina. You may now applaud. (Applause)

I now turn over the rostrum to Mr. Ray Tallent, president of the American Railway Bridge and Building Association. Mr. Tallent.

President Tallent: I add my welcome to everyone. The weather is great in Toronto. I come up from Birmingham where it's about 115 in the shade to here where it's 72, and it's very enjoyable.

I would like to introduce the B&B Executive Committee. On my left, starting with Senior Vice President Byron T. Burns, structure engineer, Atchison, Topeka and Santa Fe Railway, Topeka, Kansas; Junior Vice President John J. Horney, construction engineer bridges, Union Pacific, Omaha, Nebraska; Junior Vice President Mark C. Walbrun, project manager, Amtrak, Chicago, Illinois; Immediate Past President Donald J. Lewis, bridge construction engineer, Illinois Central Railroad, Chicago, Illinois; Treasurer James M. Williams, supervisor B&B, retired, Elgin, Joliet and Eastern Railway, Gary, Indiana. Directors: Randy C. Karsten, B&B utility supervisor, St. Louis Southwestern Railway, Kansas City, Kansas; Charles E. Thompson, B&B master, CP Rail, Burnaby, British Columbia; William H. Nelson, manager maintenance of way training, Burlington Northern, Overland Park, Kansas; Leroy Davidson, engineer B&B, CSX Transportation, Corbin, Kentucky; John A. VanHuis, chief engineer structures, Wisconsin Central Limited, Fond Du Lac, Wisconsin; Thomas J. Parker, project manager, Envirodyne Engineers, Chicago, Illinois; Thomas V. Dunn, bridge engineer, Chicago and North Western Transportation Company, Chicago, Illinois; Michael L. Bradley, project engineer, Conrail, Columbus, Ohio. Gentlemen, that's our executive board. (Applause)

At this time I would like to introduce Mr. Clark, who is president of the American Railway Engineering Association and chief engineer maintenance of way, Conrail.

Greetings from AREA

Thank you very much, President Tallent. It is, indeed, an honor to be here to extend greetings from the AREA and to wish both the Roadmasters and the Bridge and Building associations a very successful and productive conference. President Al Matte of the Roadmasters and President Ray Tallent of the B&B are to be congratulated for the very comprehensive and interesting program which they have

put together. It has a variety of topics ranging from creating pride and morale in our field forces, which gets to be more difficult every day, to the English Channel project.

Our three professional organizations, in cooperation with REMSA who have assembled an impressive display of equipment and exhibits here at Toronto, represent an industry resource that is certainly capable of defining the opportunities and successfully implementing them. The support and cooperation among the organizations will ensure a continuation of the improvements we have seen in the maintenance of way side of the industry in the 1980s.

In closing I want to express again the AREA's support and appreciation of REMSA's efforts in putting on the show here in Toronto and wish the Roadmasters and B&B associations the very best for the meetings over the next three days. Thank you. (Applause)

President Tallent: Now I'd like to introduce Mr. Donald A. Himes, president of NORDCO and president of the Railway Engineering Maintenance Suppliers Association. Don.

Greetings from REMSA

President Matte, President Tallent, special guests, ladies and gentlemen, as president of REMSA I am honored to have been asked to join in welcoming the annual conference of Roadmasters and the annual conference of the Bridge and Building Association. I know that all members of REMSA join me in wishing you a most productive conference over the next three days. We hope that your stay will be a pleasant one, and if the officers and directors of REMSA can be of assistance in any way please let us know. I wish to take this opportunity to invite all of you and your spouses to the annual REMSA reception tomorrow evening in the Canadian Room at the Royal York Hotel. Complimentary tickets for registered railroad personnel and their spouses are at the REMSA ticket desk across the lobby from the registration area both today and tomorrow. The 6:30 to 8:00 hours for this reception will hopefully permit everyone to attend and still be able to keep a late dinner date. Don't forget to visit the REMSA hospitality suites in the Royal York Hotel. Thanks again and may your meetings and your stay in Toronto be rewarding. Thank you.
(Applause)

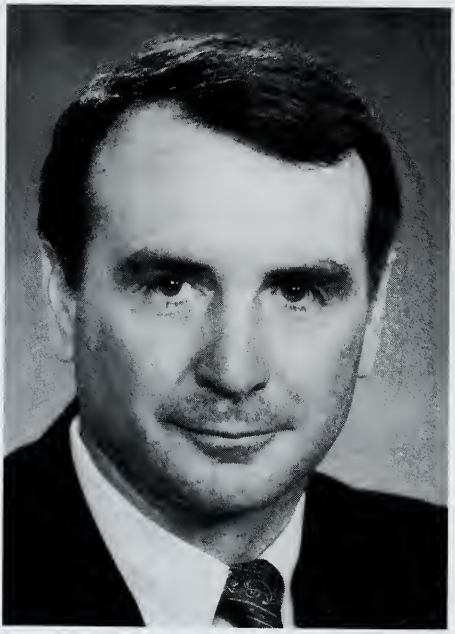
President Matte: Thank you, Mr. Himes and Mr. Clark. I'm happy to see both of you at this conference.

At this time it's a great pleasure for me to introduce our keynote speaker, Mr. Robert Jamieson Ritchie, executive vice president, CP Rail, Toronto. Mr. Ritchie was born in Ormstown, Quebec, on October 5, 1944. Mr. Ritchie graduated from Hudson Quebec High School in 1963, the McGill University in Montreal in 1967, and received his M.B.A. in 1970 from the University of Western Ontario. His career with the CP has spanned 17 years, beginning in 1970 as a research analyst and moving on from that position to a marketing representative, marketing director, marketing manager, general manager, assistant vice president marketing, vice president marketing and sales, and to his present position in March 1987, of executive vice president of CP Rail. Please welcome Mr. Ritchie.

KEYNOTE ADDRESS

Mr. R. J. Ritchie

Executive Vice President
CP Rail



Robert J. Ritchie

Good morning. I want to express my personal welcome to all of you. We may be citizens of different countries, work for different companies, and follow different railroad occupations, but we have some important common goals which I want to talk to you about today. But before I go further, I would like to congratulate the organizers of the Roadmasters and Maintenance of Way Association of America and the American Railway Bridge and Building Association for their work in arranging this excellent joint program.

I would also like to express my thanks to the members of the associations represented here today and to their presidents and other officers for granting me the privilege of delivering the keynote address to this joint session.

As many of you are probably aware, Al Matte, president of the Roadmasters and Maintenance of Way group is a key player in CP Rail's maintenance-of-way operations. I'd like to thank him for his efforts in helping to arrange this week's program.

I would also like to applaud the Railway Engineering Maintenance Suppliers Association for the major exhibitions it has organized both here downtown and out at Keating Yard. And finally, a word of welcome to those of you from the American Railway Engineering Association who are holding committee meetings here this week.

All told, we certainly have a great railroading event going on here in Toronto over the next few days. I hope our community makes a good impression on you. As I said at the outset, we're all in the railroad business, and we have some common goals. The chief one is pretty basic: making sure our railroads remain viable in this era of changing industrial cultures, technological advances, and increased competition.

I plan to develop that theme in the next few moments, emphasizing the need for a greater teamwork approach between all marketing, and operation and maintenance people in order to meet the challenges of our times. I especially want to emphasize the key role played by railroad employees who maintain the tracks and build the bridges and other structures.

If you asked me to pinpoint one major driving force that affects railroads today, I would say it is competition.

In the United States, railroads began moving into a more competitive world after the Staggers Act of 1980 went into effect. And, in recent years, your competitors in the trucking

industry have made more and more gains in the marketplace, not only on short-haul routes but also on the long hauls; and not just in the handling of manufactured goods but in handling bulk commodities too.

In Canada the story is similar. The new National Transportation Act of 1987 has not only opened the door to greater railway-to-railway competition but has led to greater service expectations from our customers. We must meet these expectations or lose out to trucks.

Railroads in both of our countries have had to hone their services to provide better value. We've had to seek out more suitable equipment, put greater emphasis on intermodal operations, improve services, and go all out to achieve greater customer satisfaction. Railroads have also had to sharpen their marketing skills. It takes more than fancy equipment and smooth talk to lure shippers away from the highway mode. In many cases, it means filling a basic customer need for dock-to-dock service from point of origin through to final destination, instead of terminal-to-terminal deliveries.

Convenient schedules and reliable 100 percent on-time services play a vital role. As you are aware, railroads are being faced with customer demands for just-in-time services to cope with low-inventory and no-inventory manufacturing operations. And there is a continuous need for improved transit times.

North American railroads have come up with a wide variety of initiatives to respond to these demands. At CP Rail, we have had considerable success with our on-time-all-the-time, or OTATT, program. It ties in with the mission statement of CP Rail Intermodal Freight Systems, or what we call IFS. This statement is only a short sentence and I will recite it here because I think it's relevant to the message I want to get across this morning. The mission statement says that CP Rail Intermodal Freight Systems "is committed to safely providing quality distribution services at competitive, cost-effective levels for the long-term benefit of customers, employees, and shareholders."

That's it. Given the new competitive era we are in, the goals outlined in that statement are similar to those of most railroads in North America, at least every one that wants to stay in business.

Those goals involve safety, quality service, competitiveness, cost-effectiveness, and benefits to the customers, to those who work with us, and those who invest in us.

It's quite obviously a good thesis for marketing and sales people. But how does it tie in to what people at this conference are discussing, railway advances and various ways of improving maintenance-of-way procedures, and the building of bridges and other structures.

I don't think I need to tell you that it has everything in the world to do with such efforts. After all, how can a railway provide competitive, cost-effective, high-quality distribution services if every employee doesn't get involved—and if there's no teamwork?

An appreciation for overall railroad goals and an all-out dedication to satisfying customer needs are especially important for those involved in maintaining the railway's fixed plant. Your innovations, skills, and efficiency in these activities can spell the difference between success and failure in achieving on-time performance and other service goals.

I realize it's easy for marketing types to say that sort of thing. However, I also appreciate that those charged with maintenance of tracks and bridges, unlike their counterparts in other industries, don't have the luxury of scheduling work as they please.

It's like show business. The show must go on. Railroads must maintain schedules to serve their customers. You can't block trains for too long; they must get through. That's the real challenge of the job, getting the work done the best way, the most efficient way, while causing as little disruption as possible to train schedules. We're all interested in new technology and new methods in your fields of endeavor—but only on those terms. After all, we have to keep in mind the competition we face from other modes. If we fail, they will fill the gap. They often have special advantages.

For example, the trucking industry has an advantage because it does not contribute a fair share of the costs of maintaining its roadways. By contrast, railroads must pay the whole shot for the upkeep of their right-of-way. Railroads have a legitimate beef there. Just the same, there's a hidden ace-in-the-hole for us in all of this, costly as it may be. We have the ability to manage fully our own roadway—something the truckers don't have. We don't depend on government to fix our roads and bridges. That's the trucking industry's Achilles' heel.

It strikes me that we should be doing our best to take advantage of our ability to manage the maintenance of our trackage and bridges along our right-of-way. Make these costly, but necessary, efforts really work for us. We should be willing to put in the needed money, if we can get good value out. That does not mean railroads should let up on our efforts to get policymakers to assess fairer cost responsibilities on the trucking industry for upkeep of the road and highway system used by our competitors. We're not afraid of competition, but we want to ensure that policymakers are not aiding one type of transport to the disadvantage of another.

As I have pointed out, in this era of increased competition, be it from truck, barges, pipelines, or ships, a greater than ever responsibility falls on those who must keep the railway system functioning efficiently and in tune with customer demands for improved services. With railroads getting more involved in just-in-time deliveries and pushing such programs as on-time-all-the-time, it is vital that we manage maintenance and maneuver work gangs in a way that causes the least disruption to services.

There are technical developments that will help railroads accomplish this. You will be discussing them in sessions this week, and you will see examples at the REMSA show. The industry is moving forward in this regard, and that's a good thing. However, there are also ways of working smarter with what we have now. Costs may have to be looked at in a broader way. Unit costs, costs-per-tie inserted, costs-per-mile of track laid, costs-per-ton of ballast, may not tell the whole story. We may have to pay extra costs for certain jobs because you scheduled the work to permit a greater flow of traffic than you would really prefer. Taking longer blocks of time to work on the tracks may look good on paper, may reduce unit costs, but it may also disrupt services to customers.

In other words, the lowest unit cost for the job might well be incompatible with the most business-like way of running a railroad. We always have to think about how maintenance of the railroad's facilities affects its ability to remain competitive. These are the trade-offs you have had to make in the past and will have to continue to work out in the coming years as our railroads face increasing competition and stiffer demands for better customer service. Only now, the matter has become more important than ever.

I mentioned the demand for just-in-time deliveries as one example of how things are changing. There's also a trend on the customer side to rationalize manufacturing operations to obtain economies of scale. As a result, the distance for shipments to and from plants is growing. This development can be good for railroads, because generally speaking, railroads can operate more economically over longer distances. Railroads could be called upon more often to exercise this advantage as this larger-plant trend develops.

If, for example, a company makes refrigerators at several plants across the continent, it may decide to consolidate its operations at one large plant with good access to transportation services. The Canada-U.S. Free Trade Agreement will likely encourage more decisions of this nature in the future. With large-scale plants, all of the raw materials or components must be freighted to the major plant, often from long distances, and then shipped out again to markets across the continent and abroad. That means that transportation, reliable, cost efficient, on-time transportation, will take on an even more important role than in the past.

The integration of the Eurpoean community's market is scheduled to take place in 1992. This may bring about similar plant consolidations abroad. The development has the potential to make European firms more competitive, putting more pressure on North American businesses to increase their own efficiency and economies of scale in order to compete. This, in turn, will place additional pressure on North American transportation firms to provide companies on this side of the Atlantic with more cost-efficient services.

At this point, it's not clear exactly what will happen in this period of changing global and domestic economies. But what is certain is that all forms of transportation are striving for more competitiveness in efforts to serve businesses that sell to domestic, North American and world markets. All of these developments will put greater pressures on those responsible for maintaining the roadbed and related facilities. There will be a greater obligation to look more closely at practical and service trade-offs before making decisions on what work to do, how to do it, and when to do it. Decisionmakers will have

to factor the engineering function more closely into service needs in an effort to meet the demands of this increasingly customer-driven era for railroading.

You might say: "The problem of schedule interruptions has always been part of the maintenance-of-way and bridge building equation. So what's new? Why are you guys suddenly being so uptight about being on-time all the time?" It's true. We are uptight. But we've never before been faced with such a demand for improved services. Business methods have changed and competition has increased. Fortunately, railroad technology has improved and more efficient work methods are also helping meet new demands. Bill Krestinski, our chief of unit engineering, will tell you more about innovations we are working on at CP Rail to meet such demands when he talks to you tomorrow morning. Efforts being made at CP Rail are, I think, just a microcosm of renewed efforts by most North American railways to meet new demands and to improve service.

What it all comes down to is that the pressure is on us all in the North American railroad industry to respond in increased competition, and we must exploit every possible advantage the railroad mode possesses. I realize that all of this puts a lot of pressure on those planning and executing our engineering operations. But that's only natural. After all, your services are really the very heart and soul of the railroad industry. What's more, your vital services should not go unrecognized. And in my book, they really count. It's not an easy task, working in remote areas, at odd hours, in all seasons, and in the worst of weather. Without such efforts, the trains wouldn't get through. Railroads would lose customers and financial viability and simply disappear. That is as true today as it was in the days of pioneer railroading. Through the years, those responsible for maintaining the fixed facilities of railroads have witnessed many changes, faced many difficulties and achieved many successes.

I am confident you will meet the challenges of the 1990s and beyond with the same kind of teamwork and commitment you have shown in the past. Thank you. (Applause)

President Matte: Thank you very much, Mr. Ritchie, for your enlightening keynote address. At this time I will turn the program over to Ken Koff who will introduce our first special feature speaker. Ken.

Mr. Koff: Thank you, President Matte. It's my pleasure today to introduce our next speaker who is Merrill Travis. Mr. Travis is chief of the bureau of railroads for the Illinois Department of Transportation and has been with them since 1967. For the last 15 years he has been deeply involved in and has concentrated on railroad issues that affect both Illinois and the country at large. He is an engineer with a Master's Degree in Administration. He has also completed coursework toward his Ph.D. in engineering at Northwestern University. I ask that you please join me in welcoming Mr. Travis.

STATE RAIL REHAB PROGRAMS

Merrill L. Travis

Illinois Department of Transportation

Good morning. I'm very honored to be here and glad to see all of you. Toronto is a lovely city.

As you know, Illinois is the nation's premier railroad state. We have more miles of track than any other state except Texas, which is about five times our size. We have a greater density of track miles per square mile of territory than any other state except Massachusetts, which is about a fifth our size. We have more railroad employees than any other state. You could tell from the introduction of the directors of the Associations this morning, certainly Chicago, and Illinois in general, enjoy our railroad industries and the advantage it gives us. I'm sure you are all aware from the newspapers and what goes on in the world that industry these days has become a slightly different business. There's an intense competition between the states and among the states to locate new industries and to keep the industries they have. We're all desperate for jobs, we're desperate for the tax revenue we get from business, and what we've found is that in Illinois our transportation is our major asset. Frankly, we have relatively high cost of labor, we have relatively high taxes. We have a rotten climate. About the only thing Illinois can offer industries as an attraction to our state or as a reason to stay in our state is its transportation system, our ability to move raw materials to processors and manufacturers, our ability to move manufactured goods directly to the population of the country. I have some slides that I'd like to show you this morning.

This slide shows state government involvement in railroad acquisition and rehabilitation projects. Most of you may not be aware but this is a growing area all across the nation. There are 30 states that now have some program of railroad acquisition, of acquiring railroad lines. Basically these are lines that are being abandoned, sometimes newer lines being constructed, but mostly abandoned lines. Over the years they've acquired some 9,611 miles for a cost of almost $400 million. As you can see, from the breakout of how they acquired it, direct state acquisition accounts for some 66 percent of those miles, 6,300 miles, with those lines in operation, not rail banked. You can distinguish them from the other category of 1,300 miles which were acquired and rail banked. I think we all believe that, in many cases, when a railroad line is abandoned, usually because of lack of traffic, that doesn't mean that the traffic won't come back some day. In Illinois we're very concerned about the abandonment and salvage of lines serving our coal fields, mostly in Southern Illinois. Illinois high sulfur coal is obviously not selling like it used to, and we're not producing it and moving it out like we used to, but that doesn't mean that we want to see all the railroads removed. So in some cases those lines could be rail banked. Illinois does not do rail banking and, in fact, does not acquire railroad lines. We prefer to see the railroad industry remain in private hands without any governmental ownership involved. Some other states take a different approach to it. Two-thirds of the miles acquired by the state are still in private operation with no subsidy. What the states have done is subsidize the ownership costs. So in other words, the new operator has an advantage over the old operator by not having also to amortize his purchase price over the sum cost of the acquisition of the line. Some 1,500 miles are directly operated by states and there's some 694 miles, a very small percentage, and it gets smaller every year, of lines that are in private operation but subsidized by the state governments.

With regard to rehabilitation, which we in Illinois have been more concerned with, some 46 states have had or now have railroad rehabilitation programs. Over 13,000 miles of track have been rehabilitated in this country with financial assistance from the states at a cost of one and a half billion dollars. The predominate mode of financing is straight grants, from the states to railroads or other track

owners, for 7,600 miles or 58 percent.

Loans for rehabilitation have become, I think, the wave of the future. What the states are doing, basically, is subsidizing the cost of the money so a railroad doesn't have to look at market rates of 10 percent or better, but instead can receive the funds from the state at more favorable rates, and that subsidizes again the cost of doing the project. Some 3,400 miles have been rehabilitated through loans, and there are some states that do direct rehabilitation with their own forces for over 2,000 miles.

I think the key to this chart on funding rehabilitation is that 99.8 percent of these rehabilitation projects are not funded through any taxes on the railroads. There is, I think, only one state that has some sort of tax on rail operations and dedicates the funds derived from that to rehabilitation projects. It's not to say that railroads don't pay taxes, they pay property taxes, they pay sales taxes, payroll taxes, etc., but the point is that no new taxes have been added to bring on these new state programs of assisting in the rehabilitation of these lines, the retention of lines, the construction of new lines. The predominant mode of financing is from the state general revenue funds. That's where Illinois' funding comes from at this point with, again, a vanishing percentage coming from the federal government. They've pretty well gotten out of the rehabilitation of railroad projects. Also some funding comes from state highway and other funds.

This slide shows the extensive network of lines in Illinois. More importantly, these are the miles that have been abandoned since 1976. We've lost over 3,000 miles of track since 1976 in the state of Illinois, which is more miles than most states have. We still have over 8,000 miles of track. You can see parts of many systems here. The colors don't show up very well, but what they represent is miles of track that have been restored to service by state projects, acquisition by the railroads, financing of rehabilitation, and so forth. The red lines on the map are pending and potential abandonments. These are lines that we think have some marginal traffic that look like they may do well in the future. This is the Norfolk Southern line down to Gibson City, where they are now going to run on the parallel Illinois Central line. It's an abandonment that's going to happen shortly. A lot of these green lines are the old Rock Island line from Chicago to the Quad Cities and down to Peoria that's owned and operated in various ways from Chicago to LaSalle-Peru, about the middle of the state, under a 99 year lease by CSX Corporation. From LaSalle-Peru and on to the Quad Cities and on across Iowa, trackage has been purchased by the Iowa Interstate Railroad. The LaSalle area, Bureau Junction it's called, down to Peoria has been purchased by B. F. Goodrich to serve their plant. It's been rehabilitated with state assistance.

Now I'd like to show you some slides of sample projects that the state has been involved with over the last few years. As you can see from the map of the state there are little blue dots that are projects that we've had since 1980 or so. 1980 was considered a watershed for us where we changed from subsidizing the operation of a railroad and from heading down a path that was taking us toward the acquisition of railroads. It became strictly a capital assistance program to railroads. And we've been all over the state as you can well see. Here is our rail freight program, just in the state of Illinois, again some of the important points on this, $7.3 million, and this is just supplied by the state in the last eight years. We got $10.7 million from the federal government, so we have a total of $18 million of governmental investment. With that we've leveraged $108 million worth of private funds and those are railroad funds, industry funds, whatever we could go out and find to help do the projects. We put these funds together, and the projects that they've financed have saved or created nearly 15,000 jobs in the state of Illinois, and that's the point to us, keeping the jobs in the state.

This is a start on our sample project. Believe it or not this is a Rock Island passenger main from Peoria north to Chicago. This was carrying passenger trains in 1980 and early 1981 and this slide was taken in 1984. It doesn't take long for Mother Nature to take back the lines. In Southern Illinois the trees would be twenty feet high by now. That's our hi-rail in the front with a contractor's in the back. B. F. Goodrich bought these 30 miles of old Rock Island track in order to restore rail service from the south to its chemical plant in Henry, Illinois, which is about 30 miles north of Peoria. The Iowa Interstate is the contract operator for B. F. Goodrich on the line. B. F. Goodrich came to

us to look for some help in rehabilitating the line so that they could restore rail service. We got the vegetation cleaned off, replaced about half the ties, lined and tamped, had a Sperry car inspect the rail, changed out that with internal defects, and the result is a restoration of a line that Mother Nature was about to remove from us. As a result there are about 20 people employed now, operating and maintaining the line. There are increased jobs at Henry and the B. F. Goodrich plant, because now they can move Southern Illinois coal up to the plant and cut their cost of energy. We're very happy that the plant that produces PVC caustic soda got off the highways and out of unregulated trucks and into the railroad cars where we believe it can be transported much more safely through all the towns.

Another project which is one of our favorites is the North Western line in Rockford, Illinois, now under traffic. This line runs all the way from West Chicago to Belvidere, Illinois. It represents a classic case of the vicious circle that happens where traffic declines, and profitability declines, and maintenance gets deferred. Maintenance is deferred and service suffers and traffic goes down further. Because traffic goes down, profits go down and maintenance is deferred further, and you just go around and around. Pretty soon you have an abandonment despite the fact that this serves the Chrysler automobile plant in Belvidere. In early 1980 Chrysler got to the point where they looked at the plant and said, "Look, we have to retool this or close it. They're no longer making the Omnis and Horizons, we need to either retool the plant, spend a lot of money to put in new car lines or close it." They looked at the railroad service. They were having a derailment a week. When the North Western ran their last rail test car there were about three defects a mile on average in the rail. Chrysler looked at it and said, "If we loose rail service completely it's going to cost us a million dollars a month, and we can't afford that, and we're going to close the plant." That was 5,000 jobs in the state of Illinois. So we worked with the North Western and with Chrysler to try to develop a project. What it ended up being as you can see is double anchoring on the ties here to hold it together.

This is one of my favorite slides. If you notice there are six grade crossing signals visible just in this picture. It's a major street crossing, and the trains are coming through on slightly deteriorated track. The rail in Rockford was the oldest. It was rolled in 1898 and laid in the early 1920s and was still in that first position. So we had a lot of work to do on the line from West Chicago to Belvidere to the car plant. We replaced all the rail with new 115 pound continuous welded rail. We put in 57,000 crossties and all the other material. We had to do all the work under traffic here in Rockford. We took the through track out, and then went back and worked on the sidings. A lot of work had to happen at night which makes these pictures kind of dark, because it was all done under traffic. By getting some of the curves laid and ballasted we end up with a restored track, a good Class II or Class III track that can provide service in the future. As a result, Chrysler made the decision to retool the plant, made a major investment, tens of millions of dollars, and we have the 5,000 jobs secured in this state.

What the state did in this case was a $15 million project. We loaned the North Western $4.5 million at two percent interest for 20 years. Obviously, that's subsidized financing, but it was enough to make the difference to the North Western of writing it off or making the investment. What we would really like to do in this state is to convince railroads not to abandon tracks if what we have is one of these vicious circles that has made rehabilitation costs a reason for abandonment.

On the opposite end of the spectrum, you can hardly see it, but there is track there in the weeds. This is the thriving industrial area of East St. Louis, Illinois. In this case we had a new industry that wanted to move into this abandoned plant complex for brake block operation. That's the loading dock there. With a little brush cutting and weed control we got the dock exposed and the track pulled up, new ties installed under it, ballast placed, and put back down with gravel over it so they could also use it for trucks. As a result there are jobs in East St. Louis. It was $14,000 for the whole project to get this track back in shape. For $14,000 we have 18 jobs paying $20,000 each, and the place is now thriving. In fact, I think they've increased their employment. So it's just a small project, but it shows the extent of our interest in industrial projects as well as agricultural products like this.

This is Rossville Grain off CSX. The grain elevator wanted to make a major expansion. They wanted a siding off CSX for car storage, so we ended up brokering a project with the railroad and the industry to get them a decent siding with a spur off to the plant where they could do loading of unit trains on CSX and move some more grain that way rather than in trucks.

This is the old Union Electric Power Plant just across the river from St. Louis, Missouri, which is one of our more ambitious projects. It has been purchased by a transportation company in St. Louis to convert to a rail barge trans-shipment facility. All of the track had been pulled up out of Sauget, Illinois, which is just south of East St. Louis. So sometimes in order to get these industries back we have to restore the track to what it was. This is the end of the Illinois Central line. Chicago, Missouri and Western now comes down to the plant and serves it. It had just been forgotten and was becoming overgrown by weeds. The spur track was out. We restored that, built a loop track, rehabilitated the siding going north to connect to the main part of the railroad, and put in a five-track yard. This facility, as a result of this project, shipped 6,000 carloads last year, and the net cost to the state was a loan to the industry of $1.5 million at three percent interest for 15 years. So by some subsidization we created 200 jobs and we moved 6,000 carloads of freight over the railroad. For several months of this year that industry, which didn't even exist two years ago, was the largest single shipper on the Chicago, Missouri and Western.

In Kankakee we had an old Quaker Oats plant that wanted to get chosen as the site for the new centralized distribution center. Unfortunately, this was about the only track they had, one rusty old spur off the Illinois Central's main coming in, and they knew they wouldn't get the distribution center from the headquarters of Quaker Oats unless they had decent rail service. So we rehabilitated what track they had, put in new track, and ended up with a facility serving them that allowed them to secure that distribution center. Nearly 200 jobs were created and a lot of material moved by rail that used to be moved by truck.

Sometimes, as I say, the track is a little deteriorated. It's in such bad shape that it's even out. In this case, in Herrin, Illinois, the track is Illinois Central track. Herrin is a small town with a lot of industry in it, oddly enough in Southern Illinois. It was the end of a 30-mile Illinois Central abandonment. You can't rehabilitate 30 miles in order to serve one town with a few hundred carloads. What we can do is build a connection between that town with a crossing railroad. As it happens, the Burlington Northern is only a mile outside of town. So the city of Herrin bought four miles of Illinois Central track, enough to serve their industries. We rehabilitated the Illinois Central track and constructed a mile and a half connection out east to the Burlington Northern. And, again, as a result, well over 150 jobs were saved in Herrin. The industries did not have to close because they didn't lose their rail service, and we got the project moving ahead.

The newest serious state involvement is building new industrial spurs as economic incentive to get railroads to locate in our state. This is Manteno, Illinois, where a plastics manufacturer wanted to locate. From the cinder in the middle, you can see where there used to be a spur off the Illinois Central. They built those houses that sort of blocked it, but the alignment was still in the ownership of this industrial park, so we restored the track. It's more than a mile from the Illinois Central over to the industry, but it was a major employment benefit. We had a crossing of U. S. route 50 here that we had to install. This is coming down off the IC with grade crossing signals and everything else. But again, we located the industry, they agreed to move to Illinois as a result of this project, and we got the jobs. We got the payroll, and it has cost us some money to put it in.

This slide is another plastics manufacturer. This is a big industry for Illinois, moving plastic pellets, which come from the petrochemical plants on the Gulf Coast of Texas, up to Illinois and then building the plant here to make little plastic bottles, loop carriers for six packs, anything and everything in plastic. This is Shelbyville, Illinois, off of Conrail, where we needed to put in a siding and a spur to this plant. We cleaned it out, built it up, laid down a new roadbed, and finally constructed our spur coming in.

Most of our work is done with contractors off the railroad right-of-way. The railroads will put in a switch of course, if it's Class I, up to

their clearance point or up to their right-of-way line, depending upon how their labor agreements work.

In Rochelle, Illinois, we helped to develop a large industrial park. In the background on the left you can see the skeleton of an $8 million frozen foods warehouse that's going up, and there are other industries in there as well. This is the point where we've built track out and to the right. We take off in a connection to the Burlington Northern and straight out toward you in the picture is the line to the North Western. In this case, the North Western donated a couple of thousand used ties toward the project, the Burlington paid for the switch off their line and the North Western paid for the switch off their line, so we could get rail service into this frozen food warehouse. A condition of the industry locating in Illinois was the North Western installing the switch.

This is in Nashville, Illinois, which is again, a large result for a little amount of money. I think this is really the ideal of what the state wants to do with the program of building industrial spurs. This is a $44 million auto parts plant. It's a Canadian manufacturer who makes all sorts of auto parts out of plastic. They wanted a spur off the Union Pacific. This is 100 miles east of St. Louis. To get this plant to locate we had to promise to provide them with the rail. For $180,00 which is hardly much, we got it cleared out. In this case, the contractor elected to construct the track in panels down in Kentucky, truck it up to the site, and install it. I'm not sure that was the smartest thing he ever did but that was his choice. He had the track put into place and a two-track siding established beside the building. They are shipping out quite a lot of carloads now and we have 700 jobs where before there weren't any. These are good paying industrial jobs which is always important to us.

I think the point that I want to make is that not many people are really aware of the programs that are available from the states. We want to make railroad business better if we can. I'm sure you've all heard the story, "We're from the government and we're here to help", but in this case, we are. We're trying to take a business-like approach toward improving our transportation system, the parts of it that are deteriorated or constructing new parts that may be missing in order to locate industry, to get jobs, to keep the economic development strain of our state strong.

What I'd like to suggest to you is that if you have a problem where track is deteriorated and you're getting into that vicious cycle, or if you have an industry that wants to locate, but the railroad won't provide a spur and the industry says they need some help to get the spur, think of your state department of transportation, because we're very interested in adding shippers to railroads and keeping our railroad lines. Thank you very much. (Applause)

Mr. Koff: Thank you, Mr. Travis. That was a very interesting discussion about state participation in railroads. I think there is an excellent point there for saving jobs and mutually benefiting railroads and the employment in the states.

Our next presentation will be a committee report on the protection of maintenance gangs on or near main tracks. The chairman is Maxwell Mitchell, procedures and joint facilities engineer for the Norfolk Southern in Atlanta, Georgia.

SPECIAL SUBJECT NO. 2

Protection of Maintenance of Way Gangs on or Near Main Tracks

Chairman: M. B. Mitchell, Proc.& Jt.Fac.Engr., NS, Atlanta GA

Vice Chairman: J. K. Carpenter, Rdm., CSX Transp., Atlanta GA

Committee: J. A. Corrigan, Sr.Instr.M/W, Amtrak, Philadelphia PA
G. M. Noto, Supv.of Trk., Amtrak, Parlin NJ
A. M. Charrow, Asst.Supt.Mtce., AT&SF, LaJunta CO
B. B. Laughlin, Asst.Supt.Mtce., AT&SF, Oklahoma City OK
A. K. Pottorff, Dir.Mtce.Sys., AT&SF, Albuquerque NM
R. J. Tanner, Asst.Mgr.M/W Trng., AT&SF, Albuquerque NM
J. A. Yarbrough, Asst.Supt.Mtce., AT&SF, Amarillo TX
T. R. Dean, Rdm., BN, Onalaska WI
R. J. Brosseau, Asst.Supv.M/W, CP, Whitby ONT
G. R. Frederick, Supt.Prod., CN, Winnipeg MAN
R. Gregory, Sys.Engr.Prod., CN, Winnipeg MAN
R. A. Dedow, Mgr.Safety-M/W, Conrail, Philadelphia PA
D. H. Bowden, Rdm., CSX Transp., Social Circle GA
L. D. Smith, Rdm., CSX Transp., Dickson TN
J. C. Tomkins, Dir.M/W Oprn., CSX Transp., Jacksonville FL
J. E. Tuckett, Trk.Supv., IC, Gilman IL
A. R. Bobby, Gen.Rdm., METRA, Chicago IL
B. Schuster, Proj.Rdm., METRA, Chicago IL
E. P. Reilly, Asst.Chf.Engr., SP, San Francisco CA
C. D. Barton, Chf.Engr.Mtce., UP, Omaha NE
Stone Mountain Scenic Railroad, Stone Mountain GA

Introduction

Since the first railroad was built and trains began operating, it has been necessary to work on or about tracks and bridges. This immediately caused the problem of protecting the forces performing the work as well as protecting train operations. Some 150 plus years later, the same problem still exists.

This committee was charged with addressing this issue and presenting a report entitled "Protection of Maintenance of Way Gangs On or Near Main Tracks". Forty-two questionnaires were sent out to various individuals on 17 freight railroads, Amtrak and one commuter line. Responses were received from 22 individuals representing ten Class I freight railroads, Amtrak, and one commuter line. Since most smaller roads have lighter density traffic and operate in a more informal manner, I feel that some of these smaller roads' practices might be very useful to larger roads on their branch lines. Unfortunately, no one from the smaller roads responded.

In the early days of railroading, seemingly anything went as to protecting track work. Of course in the early days before there was heavy on-track equipment, one could do or "get by" with practices that today would get us all run off. Reportedly, an old practice was to watch for the approaching smoke from the steam engines. Foremen or watchmen carried a whistle to warn their gang. Then the section gang would set their tools aside and step out of the track. Because of the strictly visual nature of this method, except in case of emergency, work that obstructed the track could not be done during fog or storms. Another reported early practice was to tie a red rag to some object on

or about the track, maybe even to a close-hanging tree limb. This was done without even the benefit of a train order. The train was expected to stop or to be running at yard speed a certain distance beyond the red rag.

Your committee found essentially eight methods currently being utilized for the protection of work on or about main tracks. They are:

1. Live flags
2. Flags (without person or train order/ bulletin)
3. Conditional stop signs
4. Approach order
5. Track and time limits
6. Line-up authority
7. Track warrants
8. Track out of service

All of these methods, where used, have variations depending on the property involved, except track warrants. Surprisingly, as best could be determined from the completed questionnaires received, the track warrant works in the same manner on all properties using it.

Live Flags

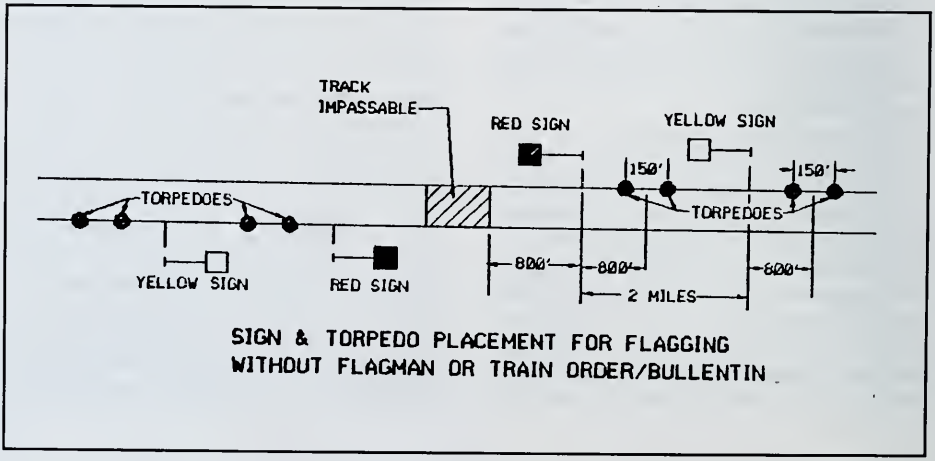
Live flags represent the most basic method now being utilized. With this type of protection, a warm body is sent out in each direction with torpedoes, fusees, and red flags. As basic as this method of protection is, I'm sure that there is no need to elaborate further on how it works. All of the reporting railroads indicated that live flag protection could be used on their property in varying degrees within all methods of train operations. Considering the high cost of this unproductive labor, for the most part, live flags are now utilized only for protection of emergency conditions or very short term work. However, some roads outright restrict the use of live flags in CTC or a train permit system to emergency use only. However, one major road requires the use of live flags in train order territory as the standard method of protection when operational considerations prohibit the use of conditional stop signs or when advanced arrangements have not been made for conditional stop signs use.

On almost all roads, after receiving instructions from a flagman, a train may be allowed to enter the flagging limits observing restricted or yard speed and any other restrictions imposed by the maintenance-of-way employee in charge.

One advantage of this type protection, if there can be an advantage to having two nonproductive men stand in the track, is that this does not require any advance preparation with the dispatcher nor does it require any communication with the dispatcher.

Flags

The use of flags without live flagmen or train order is utilized by five of the reporting roads. The manner in which this protection works is that a red sign (flag) is placed on the right hand side of the track in the direction of movement 800 feet in advance of the impassable track. Eight hundred feet in advance of the red sign, two torpedoes 150 feet apart are placed on the right hand rail. Two miles in advance of the red sign (flag), a yellow sign (flag) is placed and, as is in the case of the torpedoes for the red sign, 800 feet in advance of the yellow flag, two torpedoes are again placed on the right hand rail 150 feet apart.



SIGN & TORPEDO PLACEMENT FOR FLAGGING
WITHOUT FLAGMAN OR TRAIN ORDER/BULLENTIN

In some instances, a green flag is placed to indicate the end of the restriction. The colors of the flags and the distances involved may vary on individual roads. When a train encounters such an arrangement and does not have a train order, the train is to reduce speed, proceeding prepared to stop short of men and equipment fouling the track two miles beyond the yellow flag, and not exceeding ten miles per hour. On several roads, this is taken one step further in that on districts with timetable speed of less than 35 or 40 miles per hour and permitted by timetable special instructions, the red sign (flag) is not even required. As a further variation, some roads do not even require the use of torpedoes.

Certainly an advantage, just as with live flags, is that this type protection does not require any advance preparation or communication with the dispatcher. Of course, this protection has the big advantage over live flags in that two nonproductive people are freed from standing out in the track.

As a personal interjection however, this manner of protection strikes me as being a bit loose. With our heavier and noisier locomotives and increased sound abatement engineering for the control compartment, the ability for an engineman or other members of the head and crew to hear torpedoes is increasingly reduced. If we cannot dependably rely on the ability of torpedoes to be heard, perhaps their use should be discontinued. Otherwise, the use of torpedoes may give a false sense of security.

Just as we are experiencing increased vandalism on our property, I am sure that you are finding more instances of vandalism on yours. What is going to happen if this type of protection is being used, for instance, on 35 miles per hour dark territory and some outsider comes along and removes the torpedoes (if required) and takes down the sign(s)? A trap has been set for a major catastrophe with possible considerable loss of life. I do not mean to sound like an alarmist. I realize that several major roads have used this type of protection successfully for many years. However, when we have a situation in which we have complied 100 percent with the rules, and a catastrophe does occur, the National Transportation Safety Board, along with the Federal Railroad Administration, is going to be most critical, and again the industry is going to be in an unfavorable "limelight". This is something we do not need.

Conditional Stop Sign

While this type protection may be called "W" or "Y" order, "Form B" bulletin or some other name, it is what most using roads called "conditional stop signs." The conditional stop signs concept is used on eight of the twelve reporting railroads and has many variations. Of those eight, all permitted this type protection to be used in all methods of main track train operations outside yards, with the exception of one road which does not permit its use in centralized traffic control territory.

The basic workings of conditional stop signs is that a train order or bulletin is placed, usually upon request the preceding day, and this train order or bulletin has specific milepost limits and specified time limits. For example, the order or bulletin might read: "Approach conditional stop sign southbound at milepost 80 and northbound at milepost 85, prepare to stop and do not pass this sign until notified by radio communication or in person by maintenance of way foreman that the track is clear. This order effective from 7:30 a.m. until 3:01 p.m." In some instances all of this language is not provided in the train order or bulletin but in any event, the milepost and time limits are provided. Each day before the track is obstructed, the foreman must verify that the order or bulletin has, in fact, been issued to all affected trains.

In addition to the placement of the "stop sign" at the designated location, some type of "approach sign" is placed, depending upon the road, one and one-half miles to two miles in advance of the "stop sign" to provide early warning to the engineman.

How the train and foreman are to conduct themselves is covered by precise example in the operating rules. With this type protection, a train is not allowed to enter the limits of conditional stop signs unless it has received permission from the foreman or man in charge to proceed through the limits. After receiving permission to proceed, depending on the road, a speed may be specified. Some roads require any speed restriction to be handled in a separate train order or bulletin. If the train is given permission by the foreman to proceed as it is approaching the stop sign, it is not necessary for the train to stop, but rather, it may proceed through the limits at the specified speed. Depending upon the road, the speed restriction, if any, may be incorporated in the conditional

stop signs order, or may be required to be placed in a separate order. On nearly all reporting roads, a train may not make any reverse movement within the limits of conditional stop signs even if the involved train is a work train.

The efficient use of this protection is dependent upon having good dependable radio communications. Therefore, whenever conditional stop signs are used, we must know that our radios are turned on and working. As a personal aside, I had the misfortune when I was a track supervisor to have a gang out occupying the track, and the foreman turned his radio off. Of course the next train could not communicate with him. After the train explained to the chief dispatcher why they were stopped, an agent was sent out to find the gang and have the train released. To say the least, the transportation people were not particularly happy with having one of the "hot shot" trains delayed and consequently causing delay to other trains. If this happens many times, the dispatcher will not accept a request for their use.

I personally think that this is one of the best methods of protection available, because it is a positive form of protection with some fail safe mechanism built in (the train order or bulletin and the signs), and it does not require dispatcher involvement before and after each train that must move through the limits. However, as with any form of protection that requires the placement of signs, it takes people and time to put the signs up and take them down. In order to minimize delay to an entire gang, at least one reporting road has a couple of people come in early on overtime to place the signs so that when work time arrives, protection is in place.

Approach Order

An approach order or bulletin provides basically the same information as conditional stop signs except that the train is not required to stop. Rather, it may proceed prepared to stop short of men, track cars, or machines fouling main track. In some instances, the order will provide that the train cannot exceed ten miles per hour within the limits. Another variation allows the order to stand alone in that no signs are required. Personally, I would like to be able to use this type protection without the signs because it requires the least amount of effort on maintenance-of-way's part. However, all of one's protection is in a single basket, that is, the engineman remembering the order. With the use of signs, while there is extra effort placing them, there is the additional protection of having the signs to remind the engineman of what to do.

Track and Time Limits

Where trains are operated by a dispatcher controlled train permit system, whether in automatic block signal territory or nonsignalled territory, and in centralized traffic control and other similar signal systems, the majority of the responding roads use a track and time limits permit for the protection of maintenance-of-way work. While a track warrant control system is a type of dispatcher controlled train permit system, it does not necessarily have fixed blocks. The track warrant control system will be discussed later as a separate item.

With track and time limits protection, arrangements are essentially made on the spot and throughout the day as conditions warrant and allow. The dispatcher blocks the controlled signals in the stop mode, and where able, aligns switches away from the track(s) being used. Where trains are operated in ABS or nonsignalled territory by a train permit system, the dispatcher must know that the block is clear of any opposing movements, and that no trains have been authorized to follow the on-track movement into the block. The dispatcher then issues the track and time limits to the maintenance-of-way employee involved. Many roads using a train permit system use a computer to maintain the records. The computer is programmed so that over-lapping limits cannot be issued unless permitted by the rules, and then followed by protecting against one another in the prescribed manner.

Track and time limits, while using the same form on a given property, still may be operated in a somewhat different manner. On all reporting roads, the track and time limits are issued with fixed points which, in some instances, may be no more than "between the home signals" at a controlled point. Usually the track and time limit permit is given until a designated time. However, on some divisions of one railroad, time is given until "released". This is not a blank check so to speak. Rather when the permit is issued, it is understood that the time is

for a designated length, let's say, 50 minutes. That means that the holder of the time needs to plan his work to clear within the designated time. However, if after 35 minutes, the dispatcher sees that he can give an additional 20 minutes for a total of one hour and ten minutes, he can simply so advise the holder without actually having to issue a new permit. On some roads, if the holder is not in the clear by the expiration of time, protection must be arranged by live flags in both directions, though this is a bit difficult for a single individual in a hi-rail; while on other roads even though he is supposed to be in the clear, the rules provide that the dispatcher cannot allow another movement in the limits until reported clear.

As additional protection in a signalized traffic control territory, after obtaining track and time limits to occupy the track and make the track unsafe for passage of trains, one road requires a track signal circuit shunt to be put down. The effectiveness of the shunt must be confirmed with the dispatcher. In addition, this road requires that a physical barricade, which may be no more than laced ties, be put in place at each end of the working limits.

Frequently, there is a need to allow both a train or engine movement and a maintenance-of-way movement to work in the same block at the same time. All reporting freight roads indicated that this was allowed. some simply required that each movement have a permit covering the limits, and each movement is required to observe restricted or yard speed. In other instances, the block may be divided by separating each movement with a mile post or other fixed point. Also an on-track equipment movement is usually allowed to follow a train that is authorized to move in only one direction by advising the on-track equipment that it is following a train in the block.

The advantage of this system is that it generally does not require advance planning and does not waste manpower in the placement of signs or by utilizing live flags. Good radio or telephone communications is essential to the effective use of track and time limits. We, as well as trains, have the need to be able to reach the dispatcher quickly from any point along the route. A disadvantage of using track and time limits is that the maintenance of way is totally dependent upon the dispatcher. As we have all experienced, just as within our own department, we do not always have enough people. In many instance the dispatchers are stretched thin and cannot always get to us in a timely fashion. Thus we encounter delays, sometimes considerable delays.

All but one road allows the use of conditional stop signs in track and time limit permits system territory. For all day work such as production gang work or road crossing work this provides better protection. It allows immediate occupancy of the track after a train passes without dispatcher intervention. Also when communication with the dispatcher fails, we still have our protection and can continue to do our work.

Track Warrant Control

Track warrant control is another form of dispatcher controlled train permit system that is used in both automatic block signal system territory and nonsignaled territory, but is not used in centralized traffic control territory. This type system does not have fixed blocks, but rather allows for flexible blocks depending upon the operating situation. However, for any particular application, the beginning and ending limits that are established must have defined known points such as stations, sidings, or mileposts. One cannot simply allow a train or maintenance-of-way work to operate up to milepost 121.65 or "Buddy's Store" at about milepost 36.4. Track warrant control allows both maintenance-of-way and a train to occupy the same limits, providing that each movement protects against the other and operates at restricted speed or yard speed.

This type protection is generally transmitted by telephone or radio while at initial stations may even be transmitted via computer printer. One road even reported the use of facsimile machines for transmitting to trains at the initial station.

All reporting roads indicated that where track warrant control is in effect, computers are utilized in order to prevent issuing overlapping limits except as prescribed by the rules and then protecting as specified earlier.

Some roads also use the conditional stop signs concept in track warrant control territory. One road, even though there is no rule prohibition, does not utilize conditional stop signs for maintenance-of-way work in track warrant control territory but requires maintenance-of -way

to rely solely on track warrants for protection.

The advantages and disadvantages listed with the track and time limits also apply to the use of track warrants so will not be repeated here.

Lineup

Lineups are simply a listing of train locations at a particular point in time. Depending upon the road, maintenance-of-way movements are made by calculating the running time of trains based on the maximum speed for the particular type of train or the maximum authorized speed for all trains, to the intended clearing point. That time must be cleared by five or ten minutes, again depending upon the road. Throughout the day, lineups may be updated by determining the new train locations at a more recent time. Then the available time is recalculated based on this new information. One road even allows for a train to make a commitment that it will not leave a given point before a fixed time, and that train is then bound by the rules on that committed time even if the train is ready to leave earlier. Maintenance-of-way can then operate on the specified leaving time.

On some properties, a lineup may be used only in train order territory, while on other properties, a lineup may be used within all types of train operating territories.

Some roads allow only inspection cars, (i.e. hi-rails, motor cars, etc.) to operate under lineup authority while others allow all types of maintenance-of-way activities under lineup protection. Some allow the track to be made unsafe for the passage of trains while others do not. One road reported that until recently, they would take mechanized gangs out on the track and work under a lineup, even on nonsignaled railroad, until the determined arrival time of a train was near, then would put out a live flag only in the direction of the expected train.

Common to all roads using a lineup was the fact that whenever an on-track equipment movement was operating on lineup authority, (versus using a lineup simply for information), a train could not be operated ahead of its lineup time nor could extra trains not shown on the lineup be operated unless, depending on the road, (1) all authorized users of the lineup were notified and advised of the additional movement, or (2) any such train operating within the lineup limits, could only operate at restricted speed.

Lineups were reported being transmitted by telephone, radio, computer printer, and even facsimile machine. An advantage of the lineup is that its use requires only a minimal of dispatcher intervention, and then maintenance-of-way determines its own available time. The disadvantage is that it is not a positive measure of protection, and a train may be overlooked. All too often, when determining available time, either mistakes are made, or one tries to second-guess how a train may actually run rather than calculating a train to run at the maximum authorized speed. I personally have nearly been eaten up by a train that showed up sooner than I thought it was supposed to, as I'm sure many of you have.

Track Out of Service

As an alternative to the various methods of protection previously discussed, track may be taken out of service. This method is frequently used on branch lines and may entail no more than verbal arrangements with the dispatcher and then spiking the switch at the main line junction. Upon the completion of the work the spike is removed and the dispatcher is so advised. Some western United States roads specify in their operating rules books a formal provision of removing main tracks from service by issuance of a "track bulletin". An example of this type situation would be the removal of the main track between the switches of a siding with an alternate route being the siding. The "track bulletin" would specify the track and time limits of the out-of-service track along with the name or title of person who may authorize its use.

Temporary Speed Restriction Signs

While temporary speed restriction signs or slow order boards themselves do not actually protect maintenance work, they are very closely related to the work performed. All reporting roads except one reported that the use of these temporary speed restriction signs were required in nearly all cases whenever a slow order has been issued, regardless of whether the slow order is in a train order, track bulletin, or some other form in the engineman's possession, or simply in the bulletin book. Of these roads, some relief was allowed if the order was to be

less than 24 hours, but then the order, bulletin, or whatever the form in the engineman's hand is called, must specify that signs are not displayed.

One road reports that they never use slow order boards for any temporary speed restriction that is in the engineman's hand. They only use these signs for temporary speed restrictions of long duration that are carried in the bulletin book. This reduces the usage of these signs considerably and nearly eliminates the nuisance of constantly putting them up, moving them, or taking them down.

Training, Testing, and Qualifications

All roads reported that some form of training and testing is required. This varies from two days of training followed by an operating rules examination each year to a three or four hour session that includes an examination once every two years. In nearly all cases, the responding roads indicated that if an employee does not successfully pass the operating rules examination after one retest, then that particular employee is disqualified and barred from performing any job, such as foreman or machine operator, that requires knowledge of the rules.

Further compliance is checked day to day by maintenance-of-way supervision observing their people's work habits. Some roads require that all maintenance-of-way operating rules qualified employees have formal efficiency checks made on them once each month, while others require only that efficiency checks be made on the officers. On some properties, these efficiency checks may be made by maintenance-of-way officers, on others jointly with transportation department officers, while still on others, solely by transportation department officers.

Future

What does the future hold for new, better, more efficient ways to protect our maintenance worker? While still in very limited use, the new Advanced Train Control System technology may have great promise in helping us to protect ourselves safely from trains and yet allow us increased track time. As traffic continues to increase on certain of our lines, we must learn how to be able to utilize all of the available time by being able to get on the track as soon as a train has passed.

One reoccurring problem expressed in the questionnaires was that, in many instances, the transportation departments have cut back the dispatching forces to the bone. Often, we are not able even to utilize what should be available track time because the dispatcher simply cannot get to us. Then, when we can finally get the track, we have insufficient time to perform the task at hand. Thus, what might have been a 15 or 20 minute delay, in reality, becomes a 40 to 90 minute or longer delay since we could not perform the job at hand. This very type thing also happens to some degree in the movement of trains and switching service. What is the cost to our companies of our lost efficiency when multiplied by our hundreds of small daily activities, plus several large production gangs sitting needlessly in the hole, as well as delayed freight? I am convinced that if a cost benefit analysis were made from the viewpoint of the corporate bottom line, rather than from the transportation department's budget, the cost of additional dispatchers could easily be justified. This ability is with us today.

Most of our maintenance-of-way work begins at 7:00 a.m. and many of our people are trying to get out on the track and begin work at the 7:00 a.m. dispatchers' shift change when the dispatchers are making their turnover. An idea, provided by a committee member, that essentially should not cost anything, would be to change the dispatchers' shift change time from 7:00 a.m., 3:00 p.m., and 11:00 p.m. to 9:00 a.m., 5:00 p.m., and 1:00 a.m. With this change, most of our people would be out and on the track prior to the morning turnover, and in the afternoon, most would be off the track by the 5:00 p.m. turnover. Since many trains and line of road switch engines go to work at 7:00 a.m. and 3:00 p.m., this would also help their operations.

In order to increase on-track work time, while not a method of protection, one road has experimented with using a crane to set production gang machines on and off the track where the terrain permits a reasonably level area for crane setup and machine set off. This road built 75 pound skeleton panels that can be moved ahead with a lowboy. In this manner, all of the machines can be set on and off the main track with one crane set up. A test using a tie gang working a 45 mile segment of track, with

three trains that had to be cleared daily, was set up. The test resulted in an average increase of 70 minutes on-track work time per day and a daily tie installation increase of 352 ties. After taking into consideration the cost of the crane, the lowboy truck, and the skeleton track, there was a savings of nearly $40,000, or 69 cents per tie over the life of the project, through increased production.

Conclusion

While there may be variations in specifics such as sign placement, terminology, forms, etc., not surprisingly, almost all roads use essentially the same methods of protection.

However, from an operating rules standpoint, one road seems to have developed what I deem the best and yet the simplest methods of protection. All of their train operations are either centralized traffic control or a dispatcher controlled train permit system. The three methods of protection are (1) live flags used essentially in emergency situations; (2) track and time limits; and (3) conditional stop signs.

Conditional stop signs are used for all day type work when arrangements can be made the day before. Track and time limits is used when protection is required for short duration such as inspecting track or when it has not been possible to make advance arrangements for conditional stop signs the day before. Even the forms, signs, and bulletins, are the same in both methods of train operations. Even though this road seems to have the best and simplest methods conceptually, they still have the lack of sufficient dispatchers discussed earlier, and their dispatchers being involved in the turnover when maintenance-of-way goes to work. This simply proves that no system is any better than the people available to run it. (Applause)

Mr. Koff: Thank you, Max, for that fine speech and discussion. The slides really helped make it pleasurable to listen and watch. We have an interesting panel discussion here for our group today, hosted by John Yarbrough, assistant division manager of engineering for the Santa Fe in Texas. John will be acting as moderator and will introduce the panelists.

PANEL DISCUSSION

Contracting Maintenance Work To Outside Parties

Moderator: J. A. Yarbrough, Asst.Divn.Mgr.Engrg., AT&SF, Amarillo TX

Panelists: R. H. Preuss, Rdm., Red River Valley & Western, Breckenridge MN
K. R. Welch, Engr.of Trk.Mtce., UP, Spring TX
D. B. Foth, Exec.VP, NRC, Minneapolis MN

Mr. Yarbrough: Thank you, Ken. Good morning and welcome to beautiful Toronto, Canada. It's really a pleasure to be here this morning and to be able to address you. You know, today, already we have heard some interesting facts about how our industry is changing from the State of Railroad Address by Mr. Ritchie this morning. He told us that we need to be efficient and economical and how it's becoming more and more important for us to think of how we can change to be more efficient. We've also heard from Mr. Travis about another facet of the railway industry, the short haul line, and about how the states are beginning to filter funds into us where we can be more efficient, where we can use short hauls to keep our industry more profitable.

This program today will be a panel discussion on the possibilities and the advantages of contracting railroad maintenance to outside parties. As our industry changes so must our thinking about how to accomplish our jobs as efficiently and economically as possible. And this could mean other resources may have to be used to accomplish these tasks. This is where the contractor-type labor could be used. We will attempt to stimulate your thinking and give you some information where you may draw some conclusions as to what could be the advantages or disadvantages of using outside contract labor in doing your particular railroad duties. There'll be some time allotted at the closing of this discussion to field questions from the audience to the panelists.

On our panel today we have three people from three very different facets of the railway industry. Each one of these people has a different type job and has varying ways of accomplishing his duties. Yet they all do have one thing in common and that's the use of outside labor in these processes along with their normal work forces. My panel consists of Mr. Ron Preuss, who is roadmaster for the Red River Valley and Western Railroad, a short haul line railway headquartered in Breckenridge, Minnesota. We have also have Mr. Ken Welch who is also a short haul maintenance man. Oh no, he's from the UP, (Laughter), I guess that's not a short haul at all. Ken is the engineer of track maintenance at Spring, Texas. Ken is also a past director of the Roadmasters Association. Last, but not least, we have Mr. Dan Foth, who is the executive vice president of the National Railroad Construction and Maintenance Association, Incorporated. His office is located in Minneapolis, Minnesota. They also have a booth upstairs if you want more information later.

To start the discussion I am going to ask these gentlemen some questions and let them give you the answers. My first line of questions will be directed to Ron Preuss. Ron, how do you use contract work in your short line railroad maintenance business?

Mr. Preuss: On the Red River Valley, all facets of maintenance, including the signal and bridge is contracted out in one form or another. Some times when business is down, Red River does supplement contracts with their trainmen, who are not busy at the time, to do odds and ends jobs, but basically, it's all contracted out.

Mr. Yarbrough: Do you actually have a fixed force besides the contract maintenance you use?

Mr. Preuss: No. As I said, all work is contracted out, including my job and a fixed force which I have. We are on a long-term contract to do the basic day-to-day maintenance. Any other contract work is let out on a bid basis.

Mr. Yarbrough: When you bid your contracts, do you do that on a yearly basis or as needed, as the emergency arises? How do you handle that?

Mr. Preuss: Our capital projects or our

major projects are estimated and bid on a long-term basis but we bid a lot of our small crossings, small projects like that on a day-to-day basis.

Mr. Yarbrough: Well, since you go on an as-needed basis, and your maintenance budget program is based accordingly, when do you decide or how do you decide where to use your labor. Is that through inspection or how?

Mr. Preuss: Well, on my force I have track inspectors just like a normal railroad. In fact all my people who are on the basic force are former Burlington Northern employees. I do my inspecting along with the president of the railroad, and we make up our projects yearly.

Mr. Yarbrough: What happens on one of these bid jobs if the program is not finished on time or poor work is done? How do you handle that as supervisor?

Mr. Preuss: Time usually has not been a problem for us. We usually allow plenty of time, and we have no problems there. But poor work has not been a major problem either. We monitor all the time and correct as a problem shows up. Either my inspectors, or myself, or the president can stop it immediately when it happens.

Mr. Yarbrough: Have you encountered any real problems with the contract-type work?

Mr. Preuss: We've not had any major problems with the contract work. I have a little bit of a problem with my job because working for a contractor, and trying to estimate for a railroad, and maintain for a railroad gets to be a little bit of a problem for me, but the only other problem I have is working under traffic conditions. Contractors, historically have been working elevator tracks and tracks that are out of service, and there's no need for clearing for trains. So they're not used to clearing for trains in the proper time or knowing how their gangs should run. But we haven't had any major problems. We usually keep someone with them to protect them.

Mr. Yarbrough: So other than the president of the railroad, you inspect it. Do you have to spend any additional time watching quality or work productivity, or who actually is assigned to do that?

Mr. Preuss: Well, it has basically been my job or the president's. He comes out with me at various times and we look it over together. Productivity is not really a problem with contractors. At least the ones I have worked with so far, because productivity to a contractor means money. The faster they can get it done the better for them because the more money they make. But for the quality, you have to monitor them to start with right away. Usually with a contractor you can see their quality within the first couple of days. After that you spend less time monitoring their work, because if they start with quality you know they are going to have good quality all the way. Then it's just a follow-up monitoring.

Mr. Yarbrough: One of the main questions, I guess, is do you feel it is more economical in your particular railroad experiences to use outside or contract labor rather than a work force?

Mr. Preuss: For my particular railroad it's definitely economical because you do not have to purchase the machines needed and then there's also the obvious FELA laws. It costs a lot less when we're under the workmen's comp laws than FELA. If anybody gets injured, as most of you on main line railroads know, it usually costs a lot of money, and we work under different laws that way. Under general consensus for short haul or regional railroads I feel that it's definitely the way to go.

Mr. Yarbrough: Thank you, Ron. Next I'm going to direct the questions toward Ken Welch. As I said earlier, Ken is with the Union Pacific Railroad in Spring, Texas, and he is going to be our Class I representative.

Does it really work for a major Class I railway to hire contract labor, and is it to your advantage?

Mr. Welch: It's definitely to our advantage. We hire contract labor for specialized work outside of pure railroading, if you will. We utilize contractors for bridge and building work, vegetation control, both mowing and chemical application, and extensively use what we call equipment rental contracts.

Mr. Yarbrough: Does this contract prove to be an advantage in your cost budgeting processes?

Mr. Welch: Yes. We, through the bidding process, are able to achieve term cost figures and eliminate a lot of our labor overruns on specific projects. You can also cancel contracts quickly, and you don't have the lingering fringe benefits that may occur with your own work force. When you cut a contractor off he goes

home, and the pay stops. Work rule flexibility allows for shortened days with contractors or longer days without terrible penalties because of strict work rules.

Mr. Yarbrough: Another good question, Ron brought up part of it. By using contract maintenance is it helping the safety areas as far as your injury reporting that's required by the Federal Railroad Labor Act and for Class I railroads.

Mr. Welch: There are some trade-offs in that. We utilize contractors whose employees are covered by workmen's compensation. Therefore, if there is an injury that occurs to a contractor's employee we don't have to report it statistically to the FRA. However, on the other side, we do annually have injuries to employees working around contractor equipment. You may have employees who are not familiar with a particular piece of equipment or a particular contractor or his operators. However, we basically feel like it does help us. Just purely because of the equipment rental thing we are able to get equipment that allows us to get away from the manual labor of the daily activities. We are able to use more backhoes instead of shovels. Pure and simply we should be saving a lot of injuries there. Statistically we really don't have figures that say it is helping us, but we firmly believe that it is.

Mr. Yarbrough: I guess one of the big questions for a Class I railroad is does using contractor labor save you money?

Mr. Welch: No doubt about it. In areas where we have used contractors and used company forces on very similar projects, we have shown time and time again the unit costs on the contractor side are substantially better than on the company side. You still have to monitor the other factors. You have the quality factors and the other benefits but cost-wise where we have been able to make a straight comparison we have seen good results.

Mr. Yarbrough: Well, you have already answered it somewhat, but are there any other instances where you use contract maintenance in some specific jobs, or how do you decide in what areas you will use contract maintenance?

Mr. Welch: We contract extensively. I mentioned equipment rental. The biggest thing I am talking about in equipment rental is the backhoe to dump truck to support anything from a section gang up to a large mechanized gang in removing road crossings, digging ditches, hauling material, whatever. We contract a lot of the hauling with big trucks, we use contract brush cutting and mowing of the right-of-way, and that frees our labor force to do gauging, spotting, true track work.

We use building contract work for maintenance of buildings, putting on roofs, windows, door knobs, you name it, as well as complete construction of new bridges. We chemically spray the vegetation exclusively with contractors. We contract some of our rail testing, rail grinding, undercutting. In case of some of the tasks like undercutting, there's not enough of it that we feel we can own our own equipment, so that's a specialized piece of equipment, and we'll contract that out. We contract material loading and unloading, using contract equipment again, and that's a case there where we feel we have saved a lot of mashed fingers in unloading ties. We used to throw them out by hand, and all of us have mashed our hands on top of a gondola car or between two ties. And that's an area which we think is a factor for safety.

There's new track construction, where we're building an industry lead or a complete new yard, a new facility. We will contract that.

For roadbed stabilization we'll use outside contractors for ejection methods, buildings, some pile driving, rock bracing, and so forth.

For electrical work we use a large amount of outside contracting from air conditioners that are on the buildings to lights in the yards. So you name it, we've tried it.

Mr. Yarbrough: What type of problems, if any, have been incurred by the Class I carrier using contract labor?

Mr. Welch: I guess you have problems every day. The biggest thing is when you get into contracting in a big way, you develop an administrative problem. You have to set up ways of dealing with it, but you have work tickets, you have the bidding process. If you're going to contract you have to have good, clean contracts that make for clear understanding. Just setting up the bidding process, the daily work ticket approvals, who can approve, the approval of the invoice after the tickets all arrive back at headquarters, and then you have to have some auditing in order to take care of that. You have

contractors who you thought were reputable, and they come out, and their equipment is not what they told you they had. You have contractors who tell you that they can support whatever your needs are. They go down to the union hall and get some day labor that has never worked on a backhoe between two rails. They can dig a ditch just fine, but they can't get between those ties. So you have a constant training thing there. You have labor conflicts, no doubt, with their union forces, and that has to be dealt with.

Mr. Yarbrough: That was one of my next questions, and, since you brought up the "U" word, (laughter) how does that affect your use of contract labor?

Mr. Welch: I started out earlier by saying that we try to use contractors to support the activities that we feel are critical to our railroad and that, to us, is building track, building bridges, the things we must do well to keep trains on the track, and we try to support that activity with our contractors. Therefore, we always are cognizant of what our work force situation is. Are we fully employed? Do we have a lot of furloughed employees? We have to look at that. We look at whether we physically have the specialized equipment that's needed to do the task. The undercutter is an example of that. If we don't have the equipment then we don't usually encounter a problem with the union when we contract that out. And when we would contract an undercutter it would come with the operators and the people to maintain that specialized equipment. You have to look at where you stand with your furlough situation. You have to look to the specialization of the equipment that you are dealing with and we try to see that before it happens.

Mr. Yarbrough: Thank you, Ken. I really don't even need to direct any questions towards Dan Foth, because both these guys have given maintenance contracting a plus already, but I'll go ahead anyway.

Dan is executive vice president of the Contractor's Association. Dan, from your point of view, what are the selling points of using contract maintenance?

Mr. Foth: I think they have already been outlined. It's essentially price, productivity, an expertise that may not be in-house and quality.

Mr. Yarbrough: When would contract maintenance be a good idea?

Mr. Foth: Well, that's a little bit like the fox guarding the chicken house, how to guard the chicken house the best, but most contractors think that a railroad can literally contract out everything and have a good job. But realistically, I think a railroad needs to look at it's own particular situation and needs to determine how contract maintenance will work for it. You have a couple different examples already mentioned. We found lots of railroads that use a contractor for scheduled maintenance and rehabilitation work while maintaining a small emergency crew to handle emergency items. Other railroads, such as the Red River, contract everything out. So it really depends on what the railroads needs are and how to best utilize what resources it has.

Mr. Yarbrough: You've heard some of our earlier statements concerning your type of work. What's a contractor's policy, say if you did some work that was not accepted or rejected?

Mr. Foth: Typically, a contractor will warrant his work for a one-year period of time unless the specifications have some other type of warranty, and that warranty usually starts from the day of substantial completion of the work. Typically, if a failure of the contractor's work occurs during that one year, the contractor, at his own expense, will fix the failure. The problem that a lot of contractors run into, and it's been alluded to here a little bit, is that historically, railroads and, to a greater extent, industry track owners have done a really lousy job of developing specifications from which a contractor can do his work. You really need to spend some time up front if you're going to contract out work, developing your scope of work, your general conditions for your contracts, and any special conditions that are going to exist, so that both you and the contractor fully understand what it is he is supposed to do and not supposed to do. And that's an area that hasn't been done as well, especially with railroads in this area, as it could be.

Mr. Yarbrough: Well, is your industry affected by all our friends, the FRA, reporting for safety violations and incidents of injury?

Mr. Foth: No. Although, using that "U" word again, we are currently not required to report to the FRA. However, I understand the brotherhood is pushing the FRA, and the FRA is considering a new rule that would bring contractors under its jurisdiction. Typically,

though, contractors are probably more concerned than railroads are about the safety factor, because our workers' compensation costs are a direct result of the claims that we have against our workers' compensation insurance. And since we already suffer greatly in that area, safety is an important thing. We try to keep the injuries down to a minimum.

Mr. Yarbrough: Dan, how do you train or how does your industry train your employees, or is it even necessary?

Mr. Foth: Clearly, training is important, and most contractors utilize kind of an on-the-job training approach. I don't think it's too dissimilar from what the railroads do with their employees. We are in the process of developing some training materials, and I think we are about halfway through that process for our membership. Typically, training has been done mostly on-the-job than by any formal method.

Mr. Yarbrough: What does it take to become a contractor, and, for us in the industry, how do we know who's good and who's not, and how do we keep the fly-by-night people off the right-of-way?

Mr. Foth: Well, it takes a little more than a pickup truck and some track tools. Becoming a contractor actually is a relatively simple process depending upon the state that you're in. You decide you want to get into business, and you go into business and make yourself an expert in that area. (Laughter) And that's the way a lot of contractors start. But I think from a railroad's point of view, if you want to make sure you're getting a quality contractor on your project then you need to prequalify this guy a little bit. The American Institute of Architects has a very simple contractor prequalification form that will tell you about the contractor's past experience, his bonding capacity, what kind of insurance he has, whether he has insurance, a little bit of history on his key employees, and if you're going to be contracting work out, all that information is important to you because that's going to tell you what kind of guy he is. The fact that the guy is there selling you the work, is a super talker, and kind of a smooth operator, is all well and good, but if he hasn't got the troops behind him to do the work, then you're going to wind up with a poor job.

The other problem that we have, frankly, is that a lot of railroads sort of equate equally a contractor that has all of these quality people, insurance and bonding capacity, and a contractor that essentially has a pickup truck and some track tools, and they assume that they're going to get the equal work out of both. They assume that the guy with all the quality people and experience, who pays for his insurance and has a bonding capacity, that his cost somehow should be the same as the guy operating with a pickup truck and track tools. It just doesn't work that way. It's no different than your own operations. If you want the quality work done then there is a price that goes with that, and if you want to take a chance and go with a low-ball operator, then that's the chance you should take. But you can't equate the two operations together, because they're totally different.

Mr. Yarbrough: I have one last, loaded question. What's the future of your business as you see it?

Mr. Foth: I'm a little more excited about it after hearing these last two guys speak. (Laughter) Frankly, with the regionalization of the system and more short haul lines starting up, our business outlook, I think, is very bright. We anticipate that the business will continue to grow over the next few years. The other thing that has been very helpful is the fact that the economy, as a whole, has been good and it looks like it's going to remain that way, at least for the next 18 months. Industrial manufacturing firms who haven't done anything on their tracks for years now are finally recognizing that they need to upgrade and improve, so we anticipate a good future for railroad contractors over the next few years.

Mr. Yarbrough: Thank you, Dan. We're ready if you are to field any questions from the audience. We don't have a microphone out there, so if you would make it clear and concise to our panelists and direct it to whomever you like, and we'll repeat the question, and try to give you an answer.

Member: What type of insurance is needed? Whose liability is it when the train jumps the track?

Mr. Preuss: As far as the liability aspects of the contractor, other than myself as a contractor, it varies depending on the contract. But we, our president and lawyers on the Red River Valley, pretty much set it up for everyone, and it's a standard type of insurance that seems to work well with all the contractors who want to

bid on the job. On our basic maintenance contract, this is under a cost plus agreement, and we, in effect, Red River employees, are paid for contracting and in that situation, we're in effect working for the Red River Valley just like a normal force would be working. I don't think they would hold too much of ours in any more mistakes than they would hold the section foreman on the BN or UP for making a mistake, but as far as the regular contractors coming in, I'm sure they probably want to hold them liable for any derailment that might happen.

Mr. Foth: The insurance requirements that I've seen are typically for basic maintenance work. They require a contractor to have between $1 and $2 million general liability insurance. I have seen mass transit work up as high as $10 to $20 million. As you're all aware, or may not be aware, the insurance industry went through a fallout a few years ago and the ability to buy $10 or $20 million worth of general liability insurance or an umbrella policy is considerably more difficult today than it was then. I think what a railroad needs to look at when it's determining its insurance requirements for a contractor, is exactly what kind of risks they are trying to get covered. A lot of railroads will require a railroad contractor who has general liability insurance that covers the rail and the railroad work to also provide a railroad protective policy. It's essentially double coverage for the same work. Also the railroad's own general liability insurance typically covers those types of things. You also have to keep in mind the more insurance you require the higher the cost is going to be, because the contractor is going to turn around and pass that cost right on. So when you're analyzing what your insurance needs are I think you have to take those things into consideration. But getting back to your question, well if the train jumps the track, and it's clearly the contractor's fault, then clearly the contractor is liable for that. I don't think there is any question about that.

But as far as idemnification agreements are concerned, most contractors operate with a standard idemnification agreement that you would find in an AIA contract. In fact, for those of you who have not done much contracting work, they're not the greatest documents in the world, but it's a good place to start. The American Institute of Architects publishes a host of standard forms on about everything you can imagine from general conditions to standard contract language. That would be a good place to start as far as developing your own contract documents. I would also encourage you to give my office a call. I'm an attorney in addition to working for NRC and do this for a living or at least have, and I would be glad to help you out with information.

Mr. Yarbrough: If any of you are interested, Dan has a booth up in the exhibit hall.

Before we close I want personally to thank all three of these gentlemen for their participation. Thank you. (Applause)

Mr. Koff: Thank you, John, for that interesting panel discussion on contracting out work. Our next featured speaker is Chris Dodge with the Santa Fe Railway. Chris is headquartered in Kansas City, Missouri, and will speak to us about building morale and pride among railroad track forces.

SPECIAL SUBJECT NO. 1

Building Pride and Morale Among Track Forces

Chairman: J. C. Dodge, Asst.Divn.Mgr.Mtce., AT&SF, Lenexa KS

Committee: B. B. Laughlin, Asst.Supt.Mtce., AT&SF, Oklahoma City OK
H. G. Webb, Chf.Engr., AT&SF, Chicago IL
J. A. Yarbrough, Asst.Supt.Mtce., AT&SF, Amarillo TX
L. H. Bahls, Supt.Engr.& Mtce., BN, Galesburg IL
L. D. Smith, Rdm., CSX Transp., Dickson TN
G. R. Frederick, Supt.Prod., CN, Winnipeg MAN
R. A. Dedow, Mgr.Sfty.MW, Conrail, Philadelphia PA
R. H. Preuss, Rdm., Red River Valley & Western, Breckinridge MN
R. L. Overholt, Rdm., Rochester & Southern, Rochester NY
W. J. Thibodeaux, Rdm., SP Transp., Schriever LA
R. F. Poulsen, Mtce.Engr.Wk.Equip., UP, Omaha NE

Today we would like to discuss the building of pride and morale among the track forces. I would like to thank the committee members who actively participated in the formation of this report. We had a 50 percent response to our questionnaire, and this information was utilized in the formation of this report. As always, the support of the committee members is critical to the success of these reports.

Problem Source

In the past, the pride and morale level has been "good". Most of our workers identified with their railroad and took pride in the work that they did in their respective jobs. However, in the last few years with the mergers (both successful and unsuccessful), take-overs, sell-offs, and spin-offs, the level has lowered to a "fair" level. All of the committee members noted that the current level is constant, and there seems to be an on-going improvement in the pride and morale levels among our track forces. The committee felt that the current constant level of pride and morale is the basis we can use to grow and expand the pride and morale of our people. The idea that change is always with us, and we must be able to grasp change and work with it instead of being afraid of it, is an idea that we need to embrace fully. All of our people have had the fear of the unknown, the potential loss of employment, and the frenzied changes going on around them. All these fears need to be confronted, and they can be confronted by communication with our people.

Setting Goals

The use of communication and recognition will help build pride and morale among our track forces. This building process will use goals as one of its tools. Goals enable us to do three things:

1. We communicate our expectations for our employees, for ourselves, and for our company.
2. It enables us to see how we are doing, guide our choices, and measure ourselves against our goals.
3. More importantly, it enables us to recognize those who assist in the accomplishment of goals and for the part they play in the organization.

We need to set goals for safety, quality, and production. At the present time, the committee noted these goals are set at a high level and presented to our forces. Numerous studies show the person receiving goals will be more likely to actively seek and attain the goals if he or she

has had a part in the establishment of these goals. The track forces need to have a part in the setting of these goals by which they work and are judged. Any goals which are set must be realistic, attainable, measurable, and followed up. The system or division office is usually the one to set the goals for the safety, quality, and production.

The goals must be realistic. The person or persons setting the goal must be aware of the variety of conditions that exist on the system in order to customize the goals for the various territories; weather, track time availability, type and experience of work force, machinery, and material are all factors which contribute to the realistic goal being set.

The goals must be attainable. They cannot be set too low as the constant easily attainable goal no longer becomes a goal. It is then just another daily work pace. The goal which is set too high and is not attainable becomes a source of frustration for the track forces. A balance must be decided upon by management as to the level of the goal and how the attainment will be reached.

The goals must be measurable. The use of goals necessitates a measuring system as a means to compare the actual job performance and the recommended level. The performance of various areas of our work force are measured by different means. Safety is measured by the lack of injuries and severity of the few which do happen. Quality is measured by the finished product appearance and durability. Production is measured by units per time. Examples such as feet per hour, ties per man, and switch tie per man are some of the various types of measuring units used.

The goals must be followed up. The follow-up process can be done in many ways. The ideal situation is a face to face post job meeting where we can address the question of how we did. Did we meet our goal? If not, why not and how can we attain our goal the next time? If so, how can we do better next time, and how can we more easily reach our goal in the future? The successful completion of the goals is a means to improve the pride and morale of our people. This recognition of goal attainment is the next portion of our report.

Recognition of Goal Attainment

The committee felt the need to have a positive recognition process for our people. The type of positive recognition stirred quite a debate among the committee members. This debate centered on the effectiveness of the use of the material reward item. One thought is that pride and morale cannot be bought, and trinkets and other such material items are not effective in the promotion of pride and morale. Another thought is that the use of a material reward system is indeed part of this overall recognition system and, when used effectively, can help the building of pride and morale.

The system should be accepted by all and more importantly recognize the individuals on the gang when the goal is attained. All members of the gang must cooperate to accomplish the goals; therefore, all members of the gangs should share in the reward. It has been found that if rewards are used they must be consistent and fair. They are also very effective if publicized. Publicity is a lasting, effective means of rewarding and recognizing the accomplishment. Various railroads utilize division, regional and system newsletters for the recognition of gang goal attainment. This works well for the production gang and their various goals. However, the section gang does not have easily recognizable goals and needs to be treated differently. One possible solution for the section gang recognition is a goal which acknowledges the territory that the section maintains.

Aids for Goal Attainment

To help build the goals, the pride and morale of our people, we need to help them and ourselves by training. How does training help improve pride and morale? It recognizes that the employee is part of the team. All employees need constant education and training to better themselves. As we have previously discussed, change is always with us. Effective utilization of change is realized by the constant training we can give our people, so that they may face change in a positive light. We find four areas in which we need to improve the training of our people.

Interpersonal Relationships. How to deal effectively with people, both those employees who work for us, and how we can better work with our bosses.

Communication. How we can effectively

communicate with our people to clearly and consistently express our goals and the goals of the railroad.

Job Planning Process. The utilization of this process to more effectively do our jobs is becoming an increasingly important part of our daily life. Specifically, how to obtain goals through the planning process, how to get the job done safely, efficiently, and economically, and how to recognize and communicate the planning process to all members of the gang, so that everyone is pulling together. This builds pride and morale among our forces. We also need training in the follow-up process, so that we may learn how to improve and how to positively reinforce and reward the job well done.

Positive Reinforcement. Sadly, this is not always part of this training. This is an area where more training for our people and ourselves is needed. This positive reinforcement process takes many steps.

A. We must communicate the positive situation to our people. We need to be direct, specific, and nonpunishing in how we tell our people about the good work they have done.

B. We need to communicate the results of their actions. That is, what good has happened as the result of our people doing their job correctly.

C. We need to reward the action. A simple "thank you" spoken to individuals goes a long way towards helping build pride and morale among our people. How many of us here remember getting the thank you letter from the general manager or vice president, which was obviously a form letter with a mimeographed signature on it? I think we all realize what we did with that letter. Yet, when we received a handwritten note or a typed letter with a handwritten signature and perhaps a personal comment on the bottom, that letter is the one we appreciated, and a positive attitude was felt toward the rewarding process.

We need more training available to our people, so they can improve their technical and communication skills, be it organized through the railroad or outside educational institutions which are railroad approved and supported. This available technical training must be publicized throughout the company and supported by upper management.

Role of Labor Agreements

The labor agreement plays a part in the pride and morale of our work force. The committee felt there were numerous areas which hinder the development of pride and morale. The ability to bid down, the question of camp cars versus per diem, the need to re-establish seniority districts in accordance with new and changing territories, are some of the areas the committee felt needed improvement. There is a need to re-establish a good communication between the labor organization and the railroads. It is suggested that with the opening of good two-way communication between the labor organization and management and the elimination of these problem areas, there would be an improvement in the pride and morale of our work force. This improvement will be advantageous to both the organization and to the railroad.

Conclusions

In conclusion, the committee felt the following three areas would help the building of pride and morale among our track forces.

1. The total commitment to safety. Our people react to what their boss expects. We, as supervisors, must be sincere in our belief that the safety of our employees is indeed number one in our work place. We need to be open and honest in communicating our goals, our expectations, and recognize our accomplishments in a positive manner in the area of safe performance of our job.

2. The positive reinforcement of all of our track forces. This positive reinforcement process through various available means of recognition will help the development of pride and morale of our people.

3. Again, we need good two-way communication among all levels of maintenance of way people and the other departments we work with. We need to take the time to show other departments what we do and tell our people how our actions and our work help the entire picture on the railroad. We must stress, through communication, our part of the team effort to get our job done.

In summary, we would like again to mention a commitment of ourselves to our people, a positive recognition of the good work that our

people do for us, and, lastly, an open two-way communication between ourselves and the people that work for and with us. These three factors together will help build pride and morale among our people. It is not an easy, overnight, quick fix solution, but one that with patience and determination we can and must do. It is a never ending process, but the results are well worth the effort. Thank you. (Applause)

Mr. Koff: Thank you, Chris, for that fine report on pride and morale. At this point I'll turn the podium over to Mr. John Horney who will proceed with the program on the B&B side.

Mr. Horney: Thank you. Our next presentation is a special feature on protection and testing of underground storage tanks and will be presented by Bob Kuhn, director, environmental and mechanical design with the Union Pacific Railroad.

Bob obtained his Bachelor of Science degree from Iowa State University and his Master of Science degree from the University of Southern California. He is a registered professional engineer in the states of California and Wyoming.

Bob's work history includes the design of spacecraft structures at Lockheed Aircraft, structural and materials engineering with the department of building and safety, City of Los Angeles, partner and director of engineering with Smith Emery Company. Bob joined the Union Pacific Railroad in 1977 with a career path that has included bridge design, system B&B supervisor, director environmental engineering, and thence to his current position as director, environmental and mechanical design. Please welcome Bob Kuhn.

PROTECTION AND TESTING OF UNDERGROUND STORAGE TANKS

R. C. Kuhn

Director, Environmental and Mechanical Design
Union Pacific Railroad

Good morning. Greetings from Omaha, Nebraska, and Union Pacific Railroad. It's really a pleasure to visit Toronto and to have an opportunity to look around here in this wonderful part of Canada. It's obviously a very growing community with all the cranes in the air and all the good looking buildings that are already here. So I thank those of you who are here from Toronto for allowing us to have this experience.

I was a little amused with John's panel here a minute ago, when they mentioned the "U" word. Now, I guess we're going to talk about the "E" word. After 24 years in structural engineering you can see my career took a real turn for hard times recently here, since I've been assigned to environmental engineering. You all know what we do in that area. We're the guys who spend your money on all that extra stuff like soil cleanup and water treatment and testing and we deal with RCRA and CERCLA and we deal with our obligations as PRPs as we gradually get into paying for all of these things that we do.

My perspective has really changed a great deal since the good old days of the bridge construction and inspection. In environmental engineering topics like fueling, engine repair, car cleaning, locomotive washing, and most certainly, derailments, take on new meanings. We're concerned at our end about the residue from all these operations. When you all flush you need to picture us at the other end of the pipe. For quite a time our gurgling voices were barely heard but in recent years the laws have gotten teeth and we've been thrust naked into the limelight with little or no budget.

Dealing with a railroad and all the inertia of past practices is difficult when it comes to environmental matters. We have been, of course, subject to change like everyone else. But enforcement of environmental laws is requiring all of us to pull together to achieve compliance. My assigned topic is underground storage tanks and I have some slides I'd like to show you.

There's really more to this underground storage tank business than I can cover on an academic classwork basis in one short speech here so I'd like to give you a kind of an overview of our situation with underground storage tanks. The subject is LUST. That stands for Leaking Underground Storage Tanks. Out of the three to five million underground storage tanks in the United States, half are gas stations, 90 percent are petroleum products, 10 percent are hazardous chemicals. Estimates of how many may be leaking range all over the map depending upon what government agency you deal with, but the cost nationally as estimated by the federal government to comply with these new laws is between $50 and $100 billion and they want all that within the next five to ten years.

An underground storage tank made of steel with cathodic protection can develop leakage due to corrosion in as short a time as a year or two. Without leak detection it can go unnoticed for quite some time. In porous soils with shallow groundwater it can migrate a long way. Some states have had regulations for six or eight years for underground storage tanks, and all states are now required to have regulations.

The issue is protection of the nation's groundwater from chemical contamination. You might ask, "Why is this important?" Groundwater in the continental United States was withdrawn from the ground in 1980 at the rate of 89 billion gallons per day. Sixty billion of that was for irrigation and 12 billion for drinking. This is up from 34 billion gallons in 1950, a factor of nearly three increase in a few years. Over half the population relies on groundwater, although 95 percent of rural households use well water, 34 of the 100 largest cities also rely on groundwater. California alone used 13.4 billion gallons per day in 1980 or about 15 percent of the national use.

Estimates are that one percent or more of the nation's groundwater is now polluted. The pollution is more prevalent in cities where the water is more heavily used.

On the railroads we have good news and bad news about these underground storage tanks. The good news is that we mainly store diesel fuel, gasoline, and in most cases, not so much chlorinated solvents and hazardous chemicals. The bad news is that we've installed underground tanks at so many remote locations that they're really spread all over the system on most railroads. The challenge and now the law requires that we inventory our underground storage tanks, and address each one in the next five years in order of age, considering the oldest one first. Tank registrations were required to be filed more than a year ago, and all new tanks must be registered at the time of installation. If we use the following cost factors of $4,000 as an average removal cost, with $30,000 average replacement cost with a conforming steel tank with a cathodic protection, and $60,000 average clean-up cost per leaking tank, then a railroad with 500 underground tanks will experience the following costs:

• Removal	$ 2 million
• Replace 200 tanks	6 million
• Clean up leakers (100 tanks = 20 percent)	6 million
	$14 million

Following is a brief review of the laws:

Basic Laws (Federal)

- Underground storage of petroleum and hazardous substances (40CFR—Part 280)
- Hazardous waste management system; standards for hazardous waste storage and treatment tank systems (40 CFR—Parts 260, 261, 262, 264, 265, 270, and 271)

Today we will limit ourselves to the new law and mainly petroleum tanks.

Hazardous Substances in Underground Storage Tanks.

- Same as petroleum systems
- Plus secondary containment for tank piping

Tanks Excluded from Scope of Law

1. Hazardous wastes (regulated by other laws)
2. Wastewater treatment tanks
3. Hydraulic lift tanks
4. Capacity less than 110 gallons
5. Those containing de-minimis concentrations of regulated substances
6. Emergency spill or overflow containment tanks

The definition of an underground storage tank is any one or a combination of tanks (including underground pipes connected thereto) that is used to contain an accumulation of regulated substances, and the volume of which (including the volume of underground pipes connected thereto) is 10 percent or more beneath the surface of the ground.

Tanks excepted from the above definition:

1. Farm and residential tanks of 1100 gallons or less, storing fuel for non-commercial purposes.
2. Heating oil tanks where oil is consumed on premises where stored.
3. Septic tanks
4. Pipeline facilities (regulated by other laws)
5. Surface impoundment, pit, pond, or lagoon
6. Storm water or waste water collection system
7. Flow through process tanks
8. Gas production equipment
9. Tanks in a basement, above the floor

Certain existing tanks such as wastewater treating tanks and large field constructed tanks are deferred. This says only new tanks in these categories must comply.

Petroleum Definition-Crude Oil and Liquid Derivatives

Includes motor fuels, jet fuels, distillate fuel oils, residual fuel oils, lubricants, petroleum solvents, and used oil.

It is significant that used oil is included in this definition and not under hazardous waste as once proposed.

New Underground Storage Tanks. System Standards

Tank and piping designed and constructed with:

- Good structural integrity
- Corrosion protection
- Spill and overflow protection
- Release (leak) detection

Compliance Schedule

- After December 22, 1988, all new tanks built to new standards
- By December 22, 1990, all pressurized piping equipped with leak detection
- From December 22, 1988, through December 22, 1993, all existing tanks must be equipped with leak detection equipment or must be closed
- By December 22, 1998, all underground storage tanks must comply with new standards

Options for Existing Underground Storage Tanks

1. Meet new standards
2. Upgrade steel tanks with interior lining and/or cathodic protection, spill and overflow protection, and release detection
3. Closure

Release Detection Methods (Monthly Monitoring)

1. Automatic tank gauging with inventory control
2. Vapor monitoring wells (for volatile liquids—porous soil)
3. Ground water monitoring wells for shallow water (for liquids lighter than water)
4. Interstitial monitoring (double wall or vaulted systems)
5. Other methods: must detect 0.2 gallons per hour or 150 gallons per month
   - Monthly inventory control
   - Manual tank gauging—tanks less than 2000 gallons
   - Tank tightness testing — 0.1 gallon per hour leak rate

Operating Underground Storage Tanks

- Monthly monitoring
- Inspection and maintenance of spill and overflow protection
- Operation and maintenance of cathodic protection—periodic testing by licensed individual
- Annual tightness testing is required in some states
- Record keeping at tank location or other readily available site
- Release reporting on all spills, overfills, or leaks including investigation and remediation reports

Record Keeping at Tank Location or Nearby

- All corrosion protection reports and test records
- All repair and maintenance records
- Recent monthly monitoring reports
- Closure documentation

Tank Removal/Closure

- Notify local agency
- Develop tank removal plan
- Empty tank and dispose of contents
- Clean and rinse tank interior
- All electrical lines and pipes must be safely disconnected
- The tank must be purged of all flammable vapors
- Removal and disposal (put safety label on side)
- Soil from beneath tank tested for contamination
- Contaminated soil remediated

- Excavation back filled after approval by local authority

Safety Considerations

- Contact with hazardous substances
- Explosive hazards
  - — Sparking
  - — Vented gasses flowing to source of ignition
  - — Cutting with a torch
- Lifting procedures
- Stability of excavation
  - — Individual entering trench
  - — Structures close to trench
- Respiratory protection
  - — Vented gas
  - — Tank entry

At Union Pacific we found ourselves with several hundred tanks to deal with this first year. Our choice has been to remove and, if necessary, replace above ground. There are a lot of new tanks available "off the shelf" for above and below ground applications and I will not go into detail on this subject today.

Our tanks have come in all shapes and sizes. We have had them as small as 55 gallons and sometimes you have to look for them.

I'd like to leave you with this thought: "If you find your operations LUSTFUL, don't dispair, it is probably not as bad as it SEEPS. Just do like the RUST of us and keep on purging and digging. In five or ten years your operation should be LUST free. It's the law.

Mr. Horney: Thank you, Bob. Our next feature will be bridge and civil engineering aspects of the upgrading of a narrow gauge railway for heavy haul. Here to talk to us about that is Mr. Bob Blinco, bridge engineer for the Queensland Railway in Brisbane, Queensland, Australia. Mr. Blinco has had 22 years experience in the design, construction and maintenance of railway bridges with Queensland Railways. In his present position of bridge engineer, he is in charge of the Civil Design Office for Queensland Railways and is responsible for the design of all bridges, culverts, earthworks, and associated civil engineering structures on the Queensland Railway system, as well as the supervision and administration of contracts for the construction of new civil engineering works.

Bob has had extensive experience in the design of prestressed concrete railway bridges, this material being used almost exclusively in Queensland Railways for the last 25 years, with over 400 prestressed concrete bridges totalling 17 miles in length being constructed in that time. Please welcome Mr. Bob Blinco.

BRIDGE AND CIVIL ENGINEERING ASPECTS OF THE UPGRADING OF A NARROW GAUGE RAILWAY FOR HEAVY HAUL

R. J. Blinco

Bridge Engineer
Queensland Railways

Introduction

The State of Queensland, Australia, occupies a total area of 667,000 square miles and has a present population of approximately 2,800,000, most of whom are concentrated in the extreme southeastern corner of the state where more than 1,600,000 people reside in the conurbation comprising Brisbane (the capital), Ipswich, and Gold Coast.

Since the early 1960s, the state-owned narrow gauge railway system, which previously had only to meet the task of providing a freight and passenger service for a mostly rural based economy, has had to adapt to cope with a sudden and dramatic upsurge in the transport of large tonnages of minerals, mainly coal, for export. This precipitated the upgrading of some existing lines and the construction of a number of new lines to accommodate heavy haul mineral traffic.

Subsequently, in the early 1980s, the decision was made to electrify the busiest of the heavy haul lines in Central Queensland, and in 1986 it was further decided to extend this electrification to Brisbane. This electrification project was completed in July, 1989, with the result that approximately 25 percent of the Queensland Railways system is now electrified.

During the latter part of the 1970s and early 1980s, Australia converted its system of weights and measures from the British system (feet, pounds, etc.) to the international metric or S.I. system (meters, kilograms, etc.). Dimensions quoted in this report generally reflect the system in use at the particular time of construction.

Brief History of Early Railway Construction

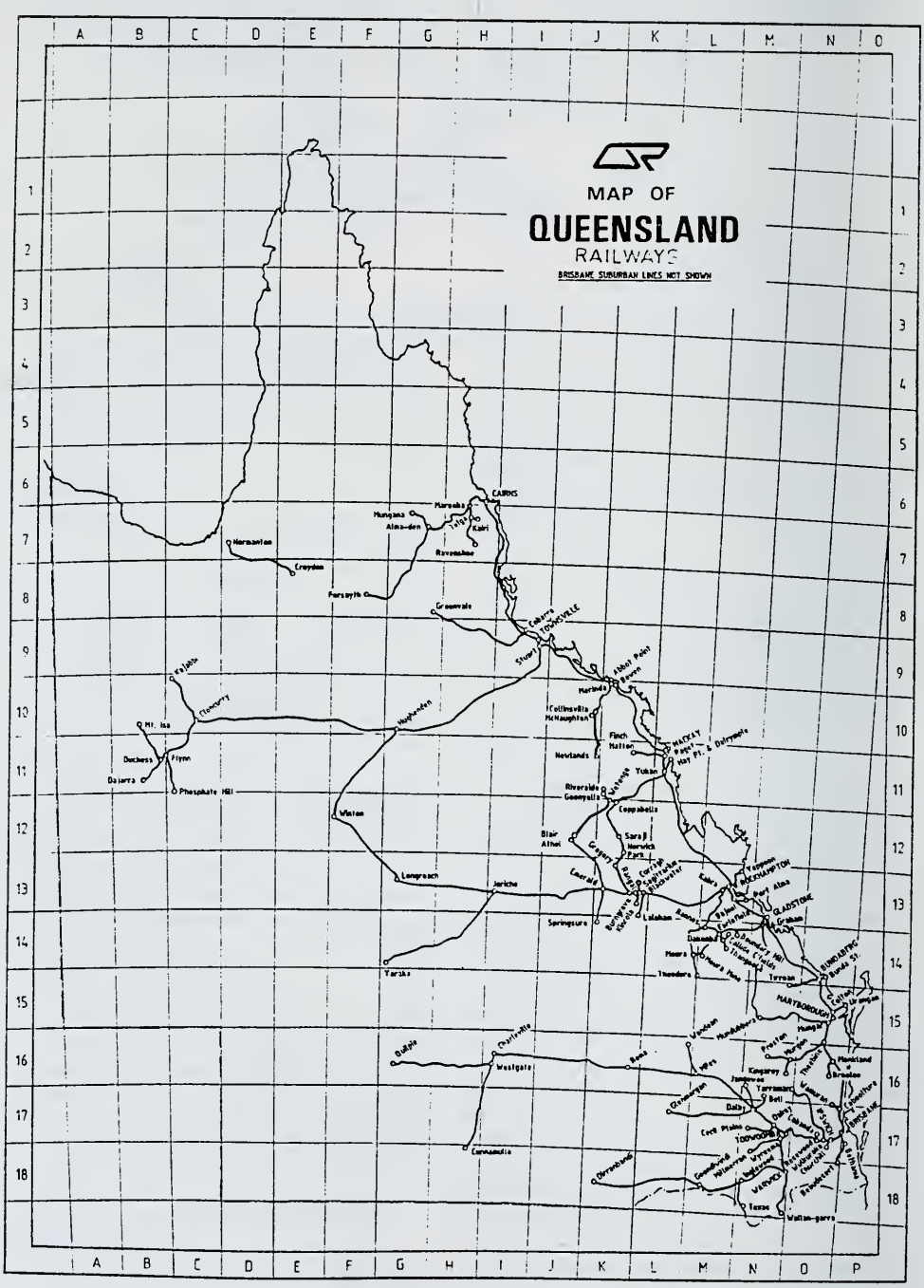
Railway construction in Queensland commenced in 1865, when the population of the state totaled less than 200,000, and this construction continued steadily until the 1920s, reaching a total length of over 6,000 miles. From the start it was a government-owned railway constructed to promote growth and to provide an incentive to populate the vast inland areas of the state.

Because of the limited financial resources, and the sparse population in a large area, the original construction was carried out to a very light standard in order to provide the greatest length of railway at the minimum cost. A narrow (three feet, six inch) gauge was chosen, and structures were built to accommodate very light axle loads (in the order of four tons). In addition, steep grades and tight curves were accepted to minimize earthworks (grades of one in 50 and curves of five chains radius or 17.5 degrees, were common).

A relative abundance of excellent quality native hardwood timbers, combined with the absence of a local steel industry, dictated that most bridges were constructed in timber, with expensive, imported steel being reserved for the larger river crossings only, where long spans were necessary.

As the population and traffic demands grew, construction standards were improved. By the year 1900 a locally developed design loading, entitled B16 (approximately equivalent to Coopers E29) had been adopted as the standard for bridge construction, and all main lines were then either built or upgraded to that standard. Subsequently, around 1914, a heavier, also locally developed, design loading known as C21 (approximately equivalent to Coopers E35) was introduced. Although all main line structures built after 1914 were constructed to C21 loading, no lines were ever totally upgraded or built to that standard, and B16 remained the

LOCALITY PLAN


MAP OF
QUEENSLAND
RAILWAYS
BRISBANE SUBURBAN LINES NOT SHOWN
CAIRNS
Mareeba
Mungana
Almaden
Kairi
Normanton
Croydon
Forsayth
Ravenshoe
Greenvale
TOWNSVILLE
Stuart
Abbot Point
Bowen
Home Hill
Collinsville
McNaughton
Finch Hatton
MACKAY
Hay Pt. & Dalrymple
Nevlands
Yukan
Riverside
Goonyella
Coppabella
Blair Athol
Sarajl
Harwich
Peak
Gregory
Curragh
Rockhampton
Duaringa
Kemmis
Yeppoon
ROCKHAMPTON
Port Alma
Kabra
Dingo
Callide
Wowan
Springsure
Lilyvale
Lakeland
GLADSTONE
Graham
Calliope
Miriam Vale
Bororen
Boyne Is.
Tannum Sands
Many Peaks
Mount Perry
Gin Gin
Bundaberg
Childers
Howard
Maryborough
Hervey Bay
Pialba
Torbanlea
Tinana
Dunolly
Theodore
Moura
Baralaba
Callide Valley
Thangool
Monto
Eidsvold
Mundubbera
Gayndah
Wondai
Proston
Murgon
Tingoora
Kingaroy
Jandowae
Tarong
Nanango
Blackbutter
Yarraman
Crows Nest
Toowoomba
Oakey
Dalby
Cecil Plains
Miles
Chinchilla
Wandoan
Taroom
Roma
Injune
Mitchell
Augathella
Charleville
Westgate
Cunnamulla
Dirranbandi
Thallon
Goondiwindi
Yelarbon
Inglewood
Texas
Warwick
Stanthorpe
Wallangarra
Dirranbandi
Bulloo
Quilpie

ruling standard to main line traffic.

The strengths of bridges have restricted and controlled the weights of locomotives and wagons ever since. The maximum axle loading on steam locomotives was limited to 12 tons. With conversion to diesel electric locomotives this was increased to 15 tons axle load, made possible by the reduced impact forces, and the wider axle spacings. Wagons were restricted to a maximum axle load of 15-½ tons. (All tons quoted are British tons of 2,240 pounds).

As will be discussed later, the influence of these low strength bridges was felt when determining the style of electric locomotives chosen when electric traction was introduced in the 1980s.

This system remained virtually unchanged, performing the task of the main land transport system in Queensland until the late 1950s and early 1960s. At that time, two forces emerged which were to change dramatically the direction of Queensland Railways. The first was the rapidly increasing competition from road transport, which was taking advantage of a rapidly improved road network. The second, and most significant, was the sudden upsurge in the mining and export of coal from the recently discovered coal fields of Central Queensland. This inspired the need to develop a transport system to move ever increasing tonnages of coal to the coast. Queensland Railways was the vehicle chosen to meet that challenge.

The Move to Prestressed Concrete Bridges

A legacy of neglect during the Great Depression and World War II was keenly felt in the 1950s with much of the system badly run down. Recognition of this condition led to an injection of funds for capital improvements, and one area targeted was the large number of timber bridges, many of which were in a poor state of repair. The by now increasing shortage of good quality timber combined with the high labor content of timber bridge maintenance prompted an on-going program to replace as many as possible with more durable materials.

In addition, with the introduction of mechanized track maintenance, ballasted deck bridges were seen to have advantages over the traditional open deck construction. The advantages, combined with the introduction of prestressed concrete technology into Australia during the 1950s, saw Queensland Railways accept this material for bridges at an early date and the first prestressed concrete railway bridge in Australia was constructed in Queensland in 1963. This acceptance was greatly influenced by the relatively low maintenance requirement of concrete over its main competitors, steel and timber.

As the technology for prestressed concrete became established, this material became more economical in Queensland than steel on a first cost basis as well.

The First Major Upgrading Project—The Mt. Isa Line

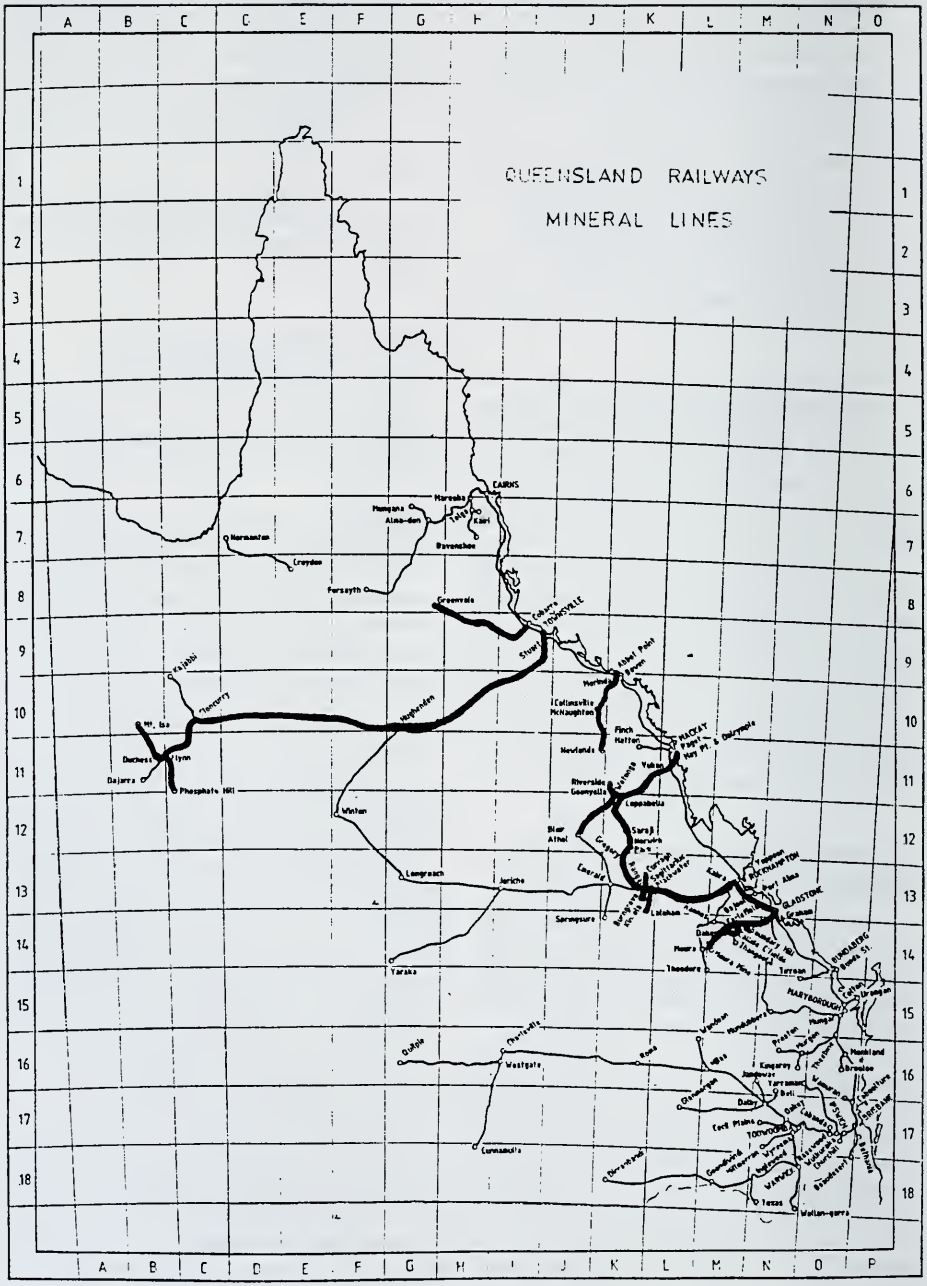
This upgrading project was put in motion mainly to meet the transport needs of Mt. Isa Mines, one of the largest copper and lead mines in the world.

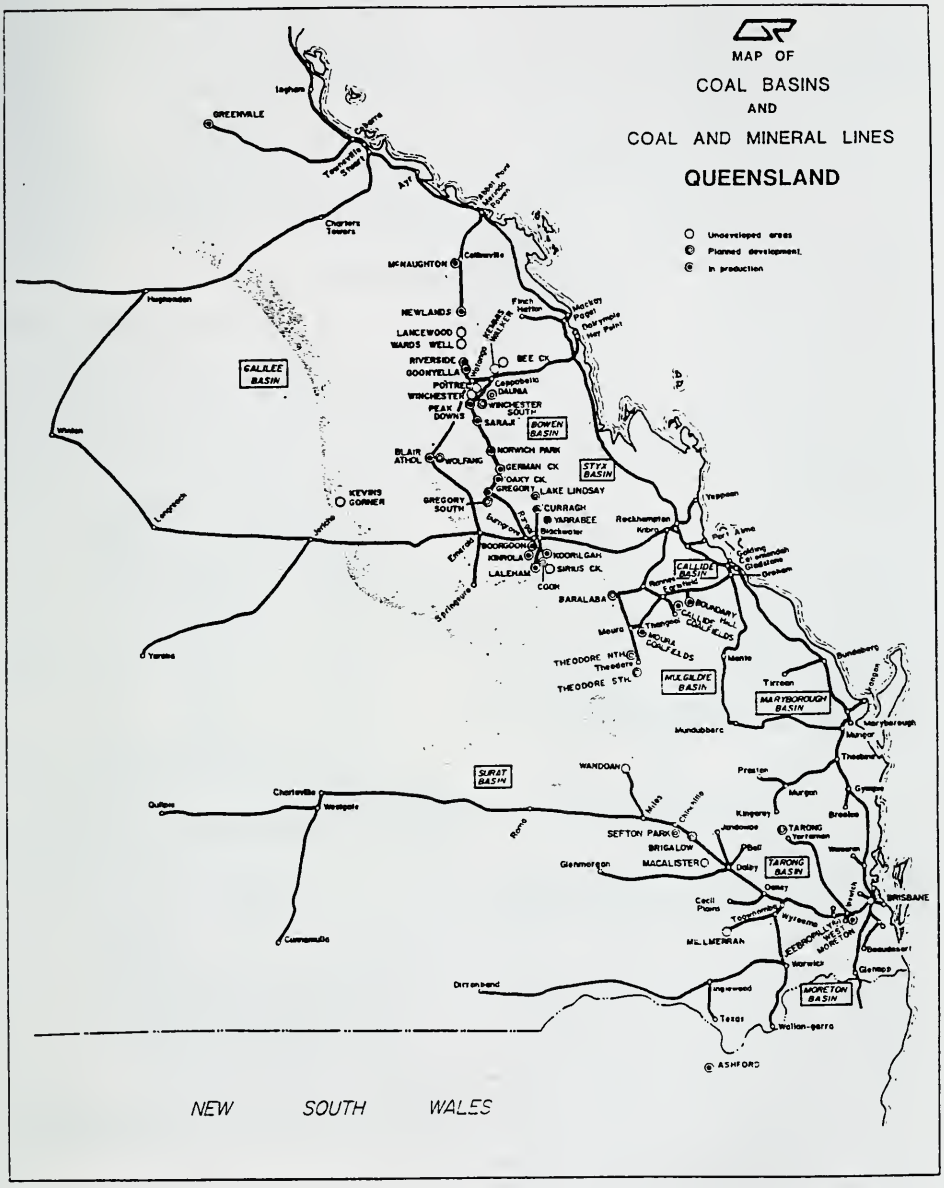
A significant part of the line from Mt. Isa to Townsville, a total length of 609 miles, had been laid across the flood plains of the Flinders River and a number of other rivers and their tributaries which flow into the Gulf of Carpentaria. The terrain is very flat, and the line had been laid virtually on the ground. During the monsoonal wet season and its associated tropical cyclones from December to April each year, it was quite common for 30 to 40 miles of track to be inundated for weeks at a time. The upgrading was carried out to raise the track to provide an acceptable level of flood immunity.

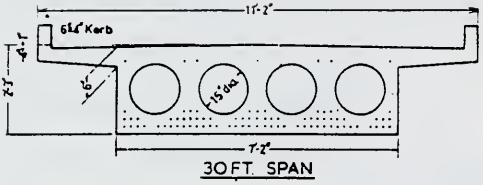
This project was significant to future civil engineering developments in Queensland Railways for two reasons. The first was the specification of Coopers E50 as the design loading for the bridges. This was the first time the bridge design load had been increased since 1914 and although still not a high loading by world standards, has proven to be adequate for the task which was then yet to confront us.

The second significant point was the exclusive use of prestressed concrete for the bridges. Although Queensland Railways had previously begun to use prestressed concrete, this project provided the impetus that saw it adopted as the pre-eminent bridge building material from that time onward. Over 130 bridges on the Mt. Isa line were constructed with superstructure in this material.

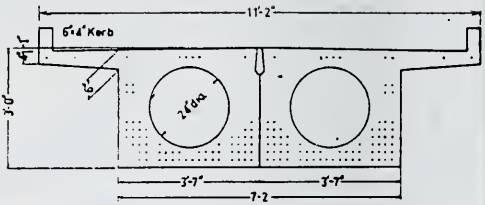
As these bridges were all relatively low


QUEENSLAND RAILWAYS
MINERAL LINES
CAIRNS
TOWNSVILLE
Normanton
Croydon
Forsayth
Greenvale
Mt. Isa
Duchess
Dajarra
Phosphate Hill
Mount Coolon
Moranbah
Lake Elphinstone
Walkerston
Sarina
Mackay
Proserpine
Bowen
Abbot Point
Hay Point
Dalrymple
Newlands
Collinsville
Glenden
Blair Athol
Lake Galilee
Jericho
Lonsdale
Yaraka
Theodore
Gladstone
Rockhampton
Emerald
Duaringa
Biloela
Callide
Dawson Valley
Monto
Mundubbera
Gayndah
Maryborough
Hervey Bay
Bundaberg
Childers
Gin Gin
Kingaroy
Nanango
Dalby
Miles
Roma
Westgate
Chinchilla
Toowoomba
Warwick
Stanthorpe
Texas
Wallangarra
Goondiwindi
Cunnamulla
Thallon
Surat
Taroom
Wandoan
Injune
Wooroolin
Tin Can Bay
Boonah
Beaudesert
Ipswich
Brisbane


MAP OF
COAL BASINS
AND
COAL AND MINERAL LINES
QUEENSLAND
Undeveloped areas
Planned development
In production
GALILEE BASIN
BOWEN BASIN
STYX BASIN
CALLIDE BASIN
BARALABA
MULGILDIE BASIN
MARYBOROUGH BASIN
SURAT BASIN
TARONG BASIN
MORETON BASIN
GREENVALE
Townsville
Ayr
Charters Towers
McNAUGHTON
Collinsville
Hughenden
NEWLANDS
LANCEWOOD
WARDS WELL
RIVERSIDE
GOONYELLA
POITREL
WINCHESTER
PEAK DOWNS
SARAJI
WINCHESTER SOUTH
BLAIR ATHOL
WOLFANG
NORWICH PARK
GERMAN CK
OAKY CK
GREGORY
LAKE LINDSAY
KEYBIS CORNER
GREGORY SOUTH
CURRAGH
YARRABEE
Rockhampton
Yeppoon
BOORGOOCH
KINROLA
KOORLGAH
LALEHAM
SIRIUS CK
COOK
Emerald
Springsure
Longreach
Winton
Yaraka
Blackwater
Kroma
Gladstone
Mount Morgan
Biloela
Dawson
Moura
Thompson
Theodore
THEODORE NTH
THEODORE STH
MOURA COAL FIELDS
Monto
Bundaberg
Tiaroon
Maryborough
Hervey Bay
Munduberra
Toowoomba
Gympie
WANDOAN
Chinchilla
Miles
Roma
Quilpie
Warrego
Cunnamulla
Preston
Murgon
Kingaroy
Brooklet
SEFTON PARK
BRIGALOW
MACALISTER
Jandowae
TARONG
Yarraman
Wooroolin
Dalby
Glenmorgan
Cecil Plains
Oakey
Toowoomba
Wyreema
Ipswich
BRISBANE
Redcliffe
WEST MORETON
MILLMERRAN
Warwick
Stanthorpe
Inglewood
Texas
Dirranbandi
Wallangarra
ASHFORD
NEW SOUTH WALES

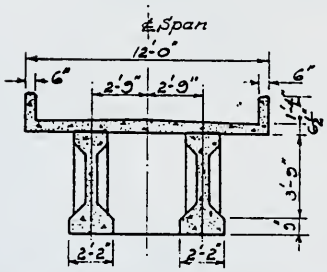


30 FT. SPAN

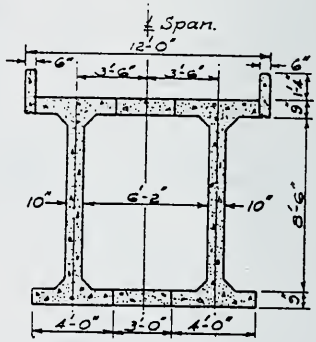


45 FT. SPAN

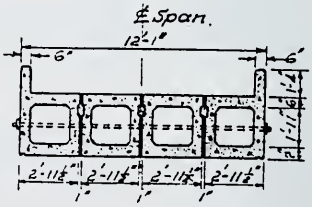
MT ISA PROJECT – STANDARD SPANS



GREENVALE RAILWAY – 60 FT. SPAN (E50)



GREENVALE RAILWAY – 120 FT. SPAN (E50)



GREENVALE RAILWAY – 45 FT. SPAN (E50)

level and over normally dry watercourses a high degree of standardization of design was achieved with only two span lengths being used throughout (30 feet and 45 feet).

Although generally performing well, these spans have exhibited fairly extensive transverse cracking in the outstanding cantilever top flanges, requiring continued sealing to prevent corrosion of reinforcement. This cracking has been attributed to a difference in shrinkage behavior between the thin cantilever sections and the massive section of the main bulk of the girders.

The Coal Projects

The early 1960s saw the beginning of the development of an export coal industry from the vast, but only relatively recently discovered, coal reserves of central Queensland. Early shipments were carried on the existing Queensland Railways system using existing small coal hopper wagons.

With the development of larger export coal mines however, it soon became apparent that heavier wagons and longer trains would be necessary, and upgrading of track and bridges would be required, to carry the projected tonnages.

Moura Short Line

The first major coal mine was established at Moura. Although a rail route already existed to Gladstone (the nearest port capable of handling bulk coal ships) the route was circuitous and much of it was of such low standard as to require virtually a complete rebuild to handle the tonnages envisaged. It was recognized that a new direct route offering a savings of 90 miles each way, or 180 miles on each round trip was a more economical proposition.

This new line was completed in 1967. All bridges were constructed in prestressed concrete to E50 standard, with spans standardized at 50 feet and 80 feet.

Upgrading Blackwater to Gladstone

In the meantime a number of export coal mines were also being developed in the Blackwater area, and short spur lines were being constructed to join the existing railway system which provided a direct route to Gladstone. A project was begun in 1969 to upgrade the line from Blackwater to Gladstone. From the civil engineering aspect this entailed the replacement of all timber bridges, major alignment and grading improvements, and upgrading of track. This was a long term project and although the last timber bridge was replaced in 1980, the upgrading continues, with duplication now being progressively carried out as new mines come on stream.

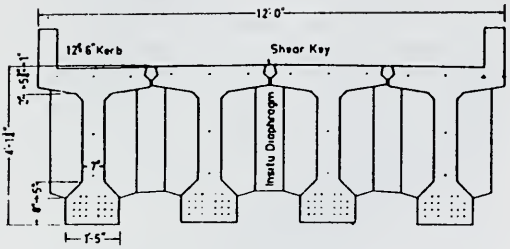
Not having the benefit of hindsight or a prior knowledge of the growth that was to occur, the early planners tried to achieve a trade off between expenditure on upgrading and the size of coal wagons to be used. As it was found possible to upgrade the major steel bridges on the route to carry a 70 ton (gross mass) wagon simply by strengthening the deck systems only, the upgrading was geared only to achieve this capability. This extended to choosing, in the interests of economy, the old Queensland Railways standard C21 as the design loading for the new bridges.

The shortsightedness of this decision is now readily apparent and as heavier wagons are being introduced on other mineral lines, this line remains restricted to 70 ton wagons. However in spite of this, 17 million tons of coal per annum are currently being transported on this line.

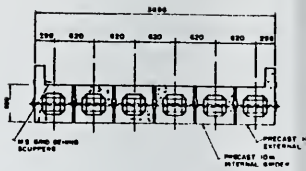
The Goonyella System

This constitutes the major heavy haul coal railway system on Queensland Railways, being a series of new lines constructed for the purpose. The initial construction was in 1971 from the mine at Goonyella to Hay Point, where a new port was developed for the project. Subsequently extensions to additional mines were constructed, i.e. to Peak Downs in 1972, Saraji in 1974, Norwich Park in 1979, German Creek in 1982, Oaky Creek and Riverside in 1983, and Blair Athol in 1984. In addition the section from Hay Point to Coppabella has been duplicated and a new port facility has been established at Dalrymple, adjacent to Hay Point to cope with the increased volume of coal. Some 38 million tons of coal per annum are presently being transported on this system.

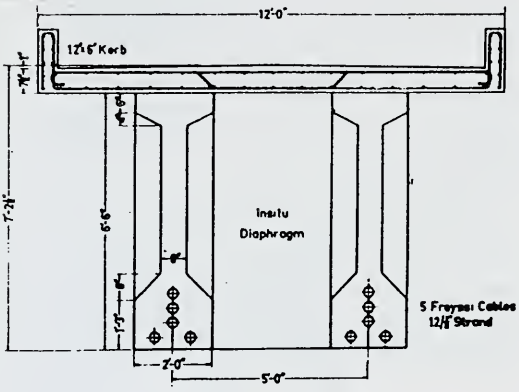
All bridges on this system are prestressed concrete to E50 design loading. Bridge spans



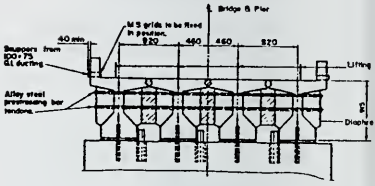
50FT. SPAN



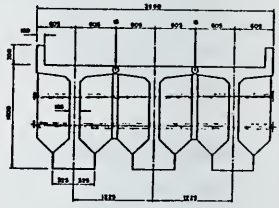
SPAN — 10.0 m
LOADING — M 220
MASS (PER GIRDER) — 6 T TONNES (INTERNAL)
7.8 TONNES (EXTERNAL)
CONCRETE STRENGTH — 40 MPa



80FT SPAN

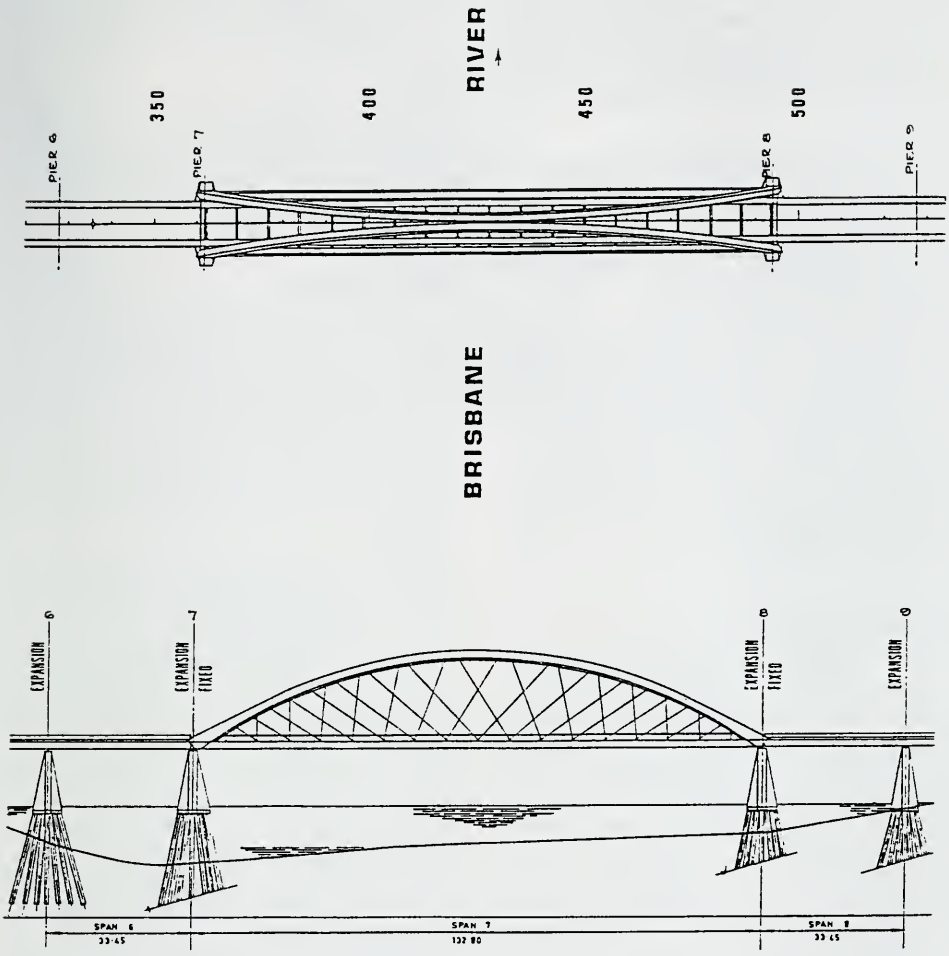


SPAN — 15 metres LOADING — M220
MASS — CONCRETE — 40 MPa



SPAN — 25 metres LOADING — M220
MASS — CONCRETE — 45 MPa

Goonyella System Standard Spans



South Brisbane to Roma Street Rail Link Main Span

were standardized initially at 50 feet and 80 feet, and at later stages, with metrication, at 15 meters and 25 meters, with some 10 meter spans. (With metrication, the Coopers E50 loading was converted into rational metric dimensions. Styled M220 (M for metric, 220 indicating at 220 kilonewton main axle load.)

Other Coal and Mineral Lines

In addition to the above, a new railway was completed in 1984 from a coal mine at Newlands to a new port established at Abbot Point, partly utilizing and upgrading an existing line from Collinsville to Merinda.

Apart from coal lines, another mineral line was constructed in 1974 in North Queensland to transport three millions tons of nickel ore per annum from Greenvale to Cobarra. This traffic has diminished over recent years. Three tunnels and 37 bridges were constructed on 133 miles of railway. Bridge spans used 34 feet, 45 feet, 60 feet, 80 feet, and 120 feet in length, all in prestressed concrete.

Track Standards

Prior to the commencement of upgrading for mineral traffic the maximum rail weight employed was 94 pound per yard which was used in limited quantities on the most heavily trafficked areas only. Rail weight of 82 pound/yard and 63 pound/yard were employed on most main lines, with 42 pound/yard used on lightly trafficked branches. Timber ties were standardized at nine inches by four and one-half inches, and depth of ballast below ties was set at six inches.

Track standards for the busiest coal lines were increased to 94 pound/yard and 106 pound/yard rails, and ties of nine inches by six inches with eight inches of ballast.

In 1980 the first prestressed concrete ties were purchased with 5,000 being tried on the Mt. Isa Line. In 1982 a contract was let for the purchase of 500,000 prestressed concrete ties for use on the Goonyella system, and usage has steadily increased since then, with 1,200,000 now in service and a further 1,000,000 programmed to be installed over the next three years. The favored fastening is the BTR-Fist fastener. A typical PSC tie (called "sleeper" in Australia) is used with ten inches of ballast.

In recent years, Australian standard rail profiles have been rationalized and 60 kg/meter and 50 kg/meter rail standards (120 pound/yard and 100 pound/yard) have been introduced.

The Coal Trains

The total amount of coal being transported by Queensland Railways is presently 65 million tons per annum with over 100 million tons per annum forecast by the year 2000.

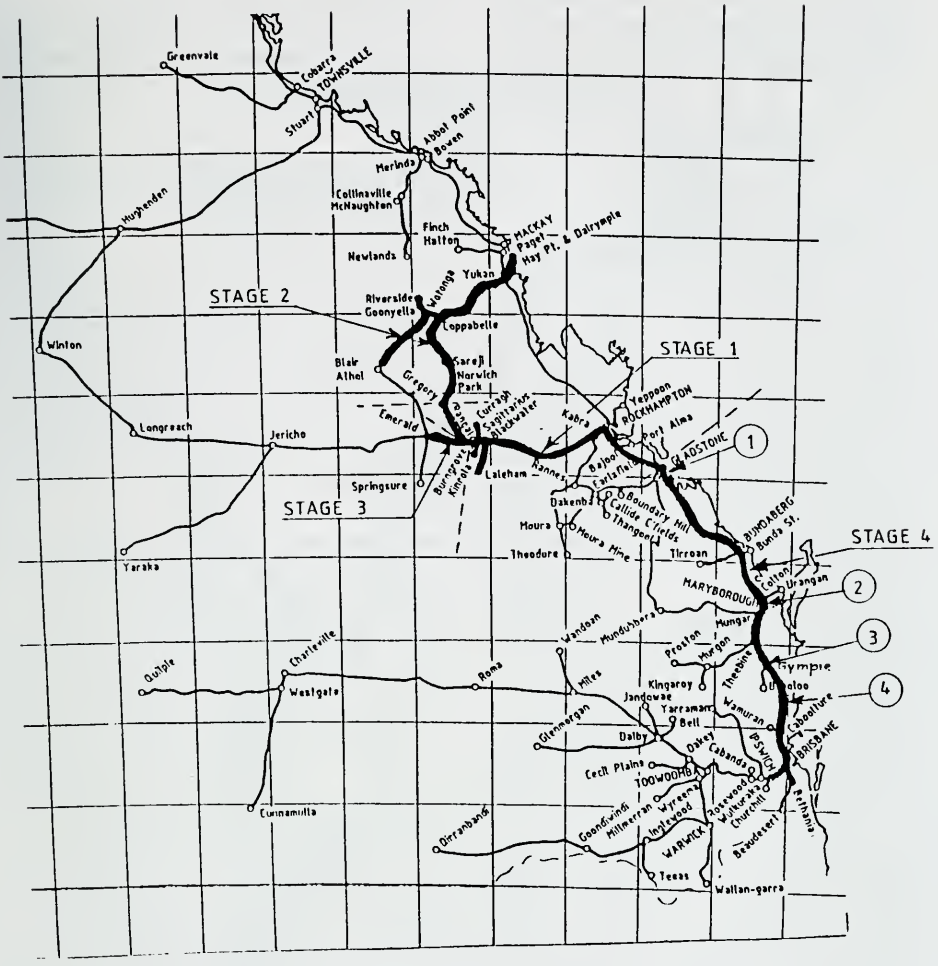
Electrification

The culmination of the developments in Queensland Railways since the 1960s is the recent completion of the electrification of some 2100 kilometers (1,300 miles) of main line track, which, added to the electrified track in the Brisbane suburban area, amounts to approximately 2500 kilometers (1550 miles) total, or about one quarter of Queensland Railways total track length.

The first electrification project in Queensland Railways was of the Brisbane suburban area which was commenced in 1976, with the first electric trains running in 1979 and, after a number of extensions to the original scope, was completed in 1984. Included in this project was a new bridge over the Brisbane River and associated viaduct which filled a missing link between the suburban lines on the north and south sides of the river. This bridge has a main span consisting of a 436 foot (132.9 meters) steel bowstring arch, the longest span on Queensland Railways. The approach viaduct spans are in prestressed concrete. These structures were designed to Coopers E60 loading to accommodate the standard gauge railway from Sydney to Brisbane. Track over the structures is dual gauge.

In the early 1980s, the availability of relatively cheap coal fired electricity in Queensland, the threat of large rises in the price of oil based fuels, and the need to replace a large number of aging diesel electric locomotives, prompted the decision to electrify the major coal carrying railways in central Queensland.

Construction commenced in 1983, and was divided into two concurrently running stages. Stage 1 comprised the Blackwater to Gladstone line and its associated coal mine branches, and Stage 2 comprised the Goonyella system. As



ELECTRIFIED LINES

STAGE 1	BURNGROVE – GLADSTONE & BRANCHES
STAGE 2	GOONYELLA SYSTEM
STAGE 3	BURNGROVE – EMERALD
STAGE 4	GLADSTONE – CABOOLTURE

MAJOR TRACK REALIGNMENTS

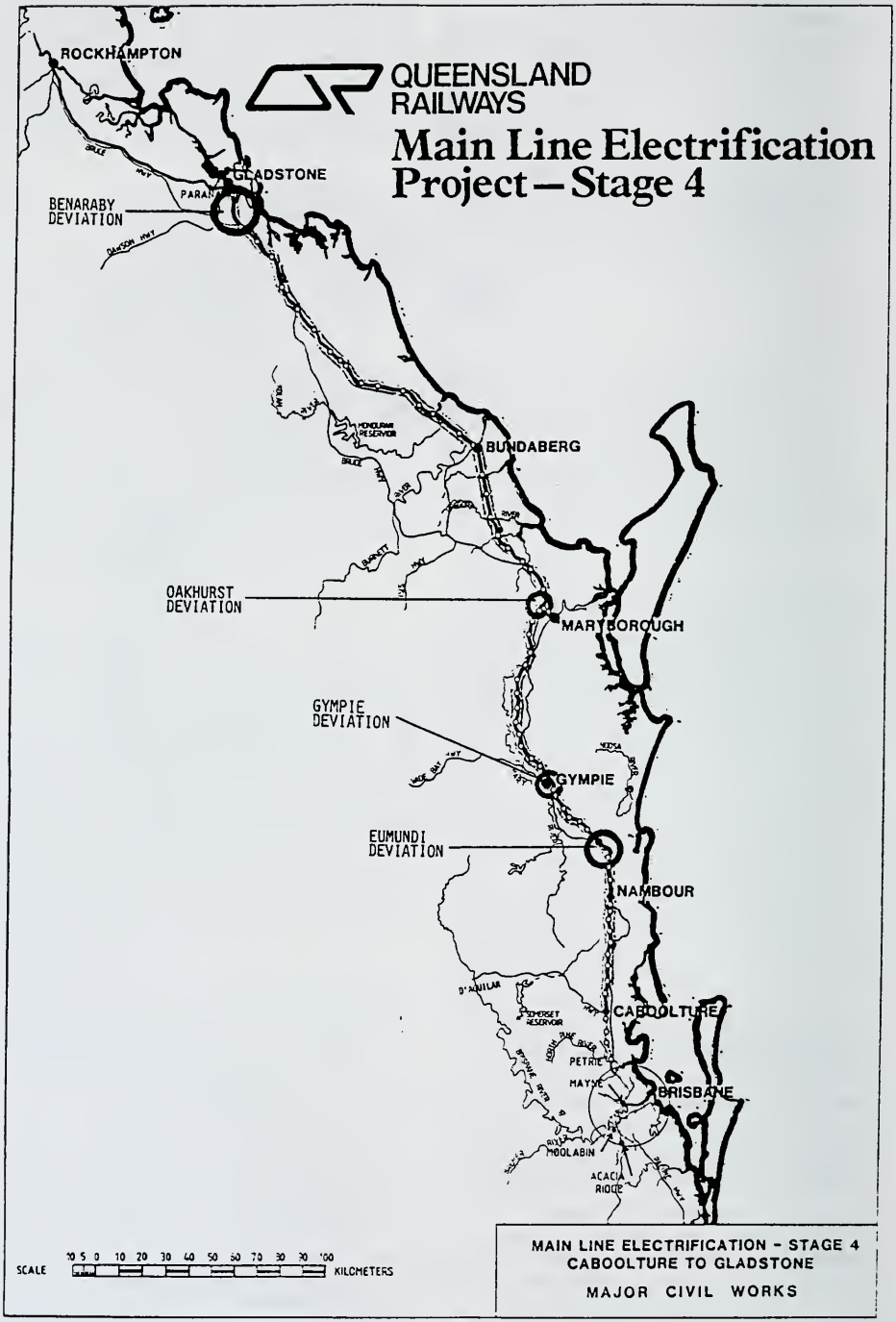
STAGE 4

(1) BENARABY – PARANA

(2) OAKHURST – ALDERSHOT

(3) GYMPIE

(4) EUMUNDI


ROCKHAMPTON
QUEENSLAND RAILWAYS
Main Line Electrification Project — Stage 4
GLADSTONE
BENARABY DEVIATION
BUNDABERG
OAKHURST DEVIATION
MARYBOROUGH
GYMPIE DEVIATION
GYMPIE
EUMUNDI DEVIATION
NAMBOUR
CABOOLTURE
PETRIE
MAYNE
BRISBANE
MOOLABIN
ACACIA RIDGE
SCALE
KILOMETERS
MAIN LINE ELECTRIFICATION - STAGE 4
CABOOLTURE TO GLADSTONE
MAJOR CIVIL WORKS

these lines had either been built or upgraded to high civil engineering standards, there was little civil engineering input required for their electrification, apart from raising of bracing on two truss bridges to provide clearance for the overhead electric wires.

However the operational advantages of extending stage 1 to a further 75 kilometers to Emerald soon brought about the decision to extend electrification to that center as Stage 3. Finally the Queensland Government decided that the link between Gladstone and Caboolture, the northernmost extremity of the Brisbane electrified area, should also be electrified and this was commenced as Stage 4 in 1986. The civil engineering input for Stages 3 and 4 was substantial as no previous upgrading works had been done on those lines.

The Choice of Electric Locomotives

A 25 KVA overhead traction system was chosen for Queensland Railway electrification and, for the coal railways, a locomotive of 108 tons mass was considered as the most desirable. This would allow a reduction of one in the number of electric locomotives per coal train compared with the number of 90 ton diesel locomotives. However the following constraints also had to be overcome:

(a) The locomotives would almost certainly be built outside the area and would have to travel over non-mineral lines to be delivered.

(b) The Blackwater to Gladstone railway still had some bridges designed to B16 loading which could possibly require replacement to accept the heavier locomotives.

(c) With the extension to Brisbane under consideration the need was seen to choose a locomotive which could safely be used on that section without the need for massive bridge reconstruction.

After consideration of a number of possibilities, a locomotive with a BO-BO-BO (Tri-Bo) axle configuration was chosen. With the body length suitably stretched, a 108 ton locomotive of this type produced the same load effects on almost all bridges, as were produced by the 90 ton diesel electric locomotives already in service. The only exception was on spans of ten feet or less where the single 18 ton axle controlled the stresses induced.

Therefore, with only a nominal cost in bridge strengthening these locomotives could also be used on any non-mineral lines which may also be electrified.

Upgrading of Stages 3 and 4

With the short length of track (75 kilometers - 47 miles) associated with Stage 3, and the recognition that the presence of electric overhead wires would add substantially to the cost of any future bridge replacement works, it was decided to replace all timber bridges on the section. Three new prestressed concrete bridges were constructed to replace the larger timber bridges on new alignments and the remaining fourteen timber bridges were replaced on alignment with precast concrete box culverts. In addition, two major steel truss bridges required raising of overhead bracing to provide clearance for the overhead wires and strengthening of stringers and cross girders to carry the electric locomotives.

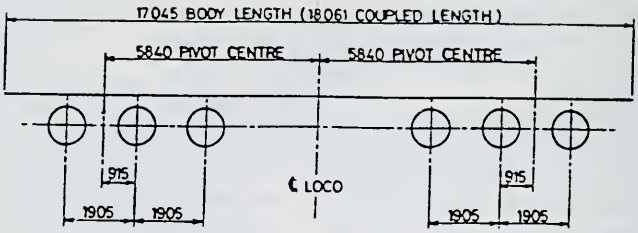
The same philosophy of replacing all timber bridges prior to electrification could not however be applied to the 530 kilometer (330 mile) Stage 4 linking Gladstone to the Brisbane suburban electrified area because of the large number of timber bridges involved, and the prohibitive cost associated with their replacement. However major civil engineering input was required into this stage of the project.

A significant portion of Stage 4 was on poor alignment and grading, and, although it was not economically possible to rebuild all such substandard sections, a requirement was identified to realign substantial parts. Two operational objectives were defined: (one) to bring grading to a standard where a single 108 ton electric locomotive could haul a 1,200 ton train over the route and, (two) to improve alignment sufficiently to enable an electric passenger service to run between Brisbane and Rockhampton in nine and one-half hours (compared with 14-½ hours for diesel hauled service).

Track Realignments

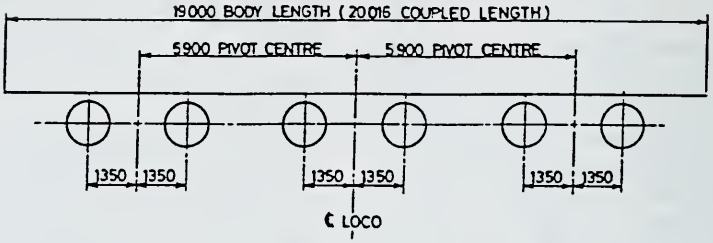
Four major realignments and seven minor realignments were constructed to meet these requirements. A brief description of each of the major deviations follows:

Eumundi. Constructed through an area of

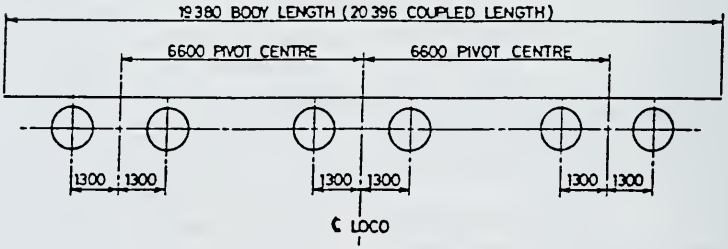


2100 CLASS D.E.L — 97·51 — POWER 1490 kW.

DIESEL LOCOMOTIVE



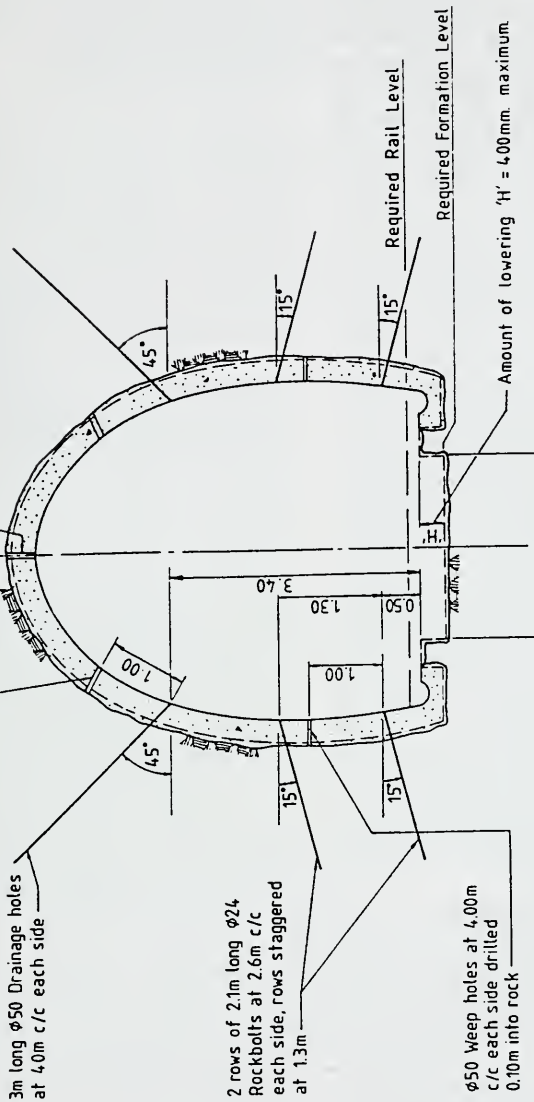
3500 CLASS E.L — 109·81 — POWER 2900 kW.



3100 CLASS E.L — 109·81 — POWER 2900 kW.

ELECTRIC LOCOMOTIVE

COMPARISON OF AXLE ARRANGEMENTS BETWEEN ELECTRIC AND DIESEL LOCOMOTIVES


℄ Tunnel
Vent holes for grouting at 3m c/c.
Grout holes at 3m c/c each side
3m long ϕ50 Drainage holes at 4.0m c/c each side
2 rows of 2.1m long ϕ24 Rockbolts at 2.6m c/c each side, rows staggered at 1.3m
ϕ50 Weep holes at 4.00m c/c each side drilled 0.10m into rock
45°
15°
7.00
3.40
1.30
0.50
1.00
1.25
1.25
Required Rail Level
Required Formation Level
Amount of lowering 'H' = 4.00mm. maximum.

TYPICAL CROSS SECTION

MAIN LINE ELECTRIFICATION STAGE 4
LOWERING OF TUNNELS

high steeply sloping hills, this deviation improved grades from 1 in 48 to 1 in 90 and eliminated a number of sharp curves. Construction entailed approximately 1,500,000 cubic meters of earthworks, two rail bridges and two road overpasses. Total length is 10 kilometers and cost was approximately $20 million.

Gympie. This realignment bypassed the hilly city of Gympie through which the old railway followed a tortuous route. Grades were improved from 1 in 45 to 1 in 97. Earthworks totalled 830,000 cubic meters and seven railway bridges and two road overpasses were constructed. Total length is 9.5 kilometers and cost was approximately $13.5 million.

Oakhurst to Aldershot. This new alignment reduced the distance between these two centers and provided operational benefits by bypassing a particularly cumbersome situation at Baddow when passenger trains were required to be backed into the platform. This project was seven kilometers long, cost approximately $6,500,000 and comprised 250,000 cubic meters of earthworks and three rail bridges.

Benaraby to Parana. This deviation replaced a 17 kilometer section consisting of a continuous succession of tight curves which wound around a number of tidal flats and hillsides. With 1,300,000 cubic meters of earthworks, three railway bridges and one road overpass, this deviation cost $A20,000,000.

The minor deviation works totalled 9.5 kilometers in length required 235,000 cubic meters of earthworks and cost $A5,500,000.

All road crossings on these works were grade separated.

Other Civil Engineering Works

In addition to the above, a substantial amount of civil engineering construction was necessary to provide clearances for the overhead traction wiring and for other reasons. This work consisted of:

A. All overhead truss bracing required raising. This comprised 14 bridges totalling 38 truss spans. Different designs were necessary to accommodate the six different truss span designs on the route.

B. A total of 13 road overbridges required raising to provide clearance while the track was lowered under an additional four. Fortunately all of the bridges were of timber construction which could readily be raised for a relatively modest cost. Roadworks were also necessary to regrade the road approaches to the raised bridges. In addition, two bridges could not be successfully raised and needed reconstruction. This work cost $1,500,000.

C. Two tunnels on the route also provided insufficient clearance for the wires. After investigation of a number of alternatives it was concluded that the most feasible and economical method of providing adequate clearances was to lower the tunnel floors by a depth varying from 300 to 400 millimeters (12 to 16 inches).

The tunnels were constructed through very hard sandstone and were 180 meters and 200 meters in length. Extensive exploratory drilling was carried out and a large amount of preliminary work was performed prior to the actual lowering. This preliminary work consisted of rock bolting, grouting of voids behind the tunnel lining, and on-site trials of rock breaking equipment to determine achievable work rates to enable accurate programming of the work.

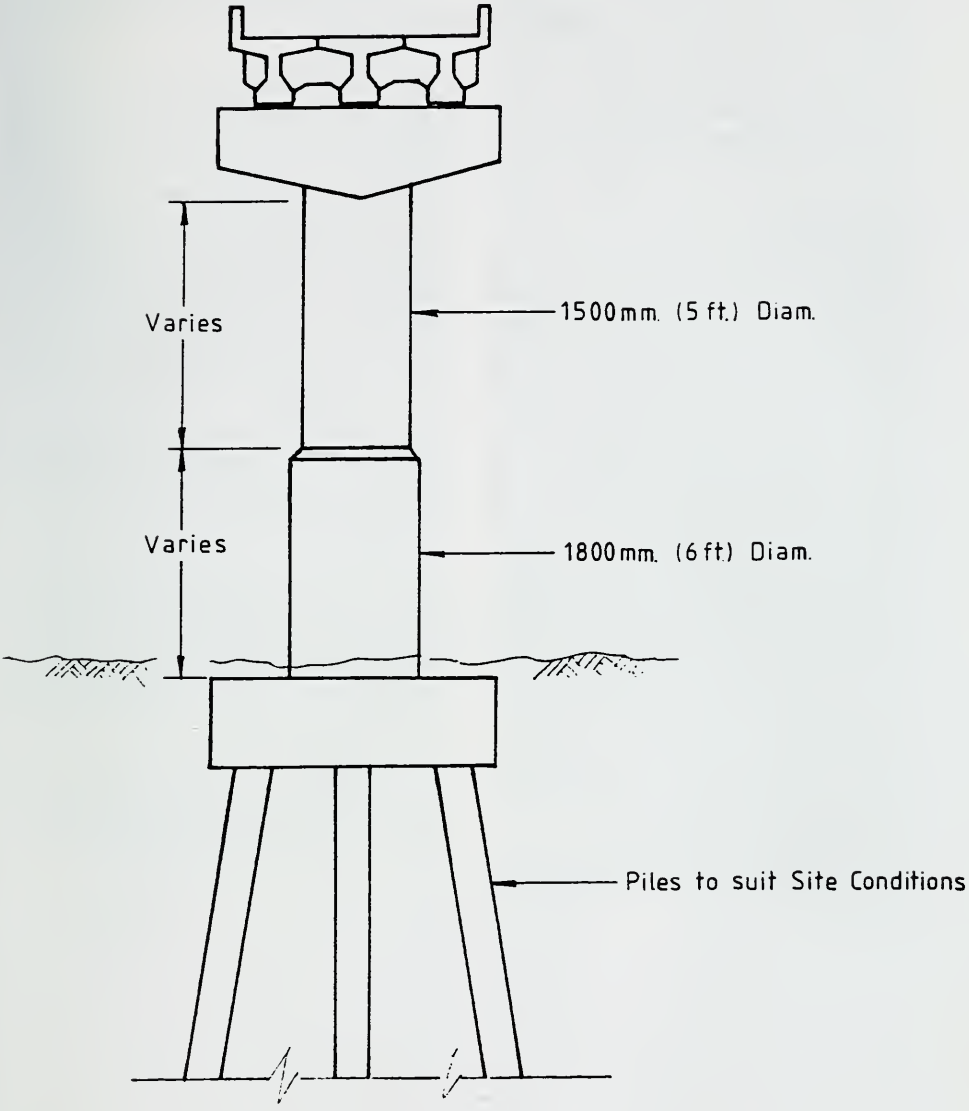
The actual work of lowering was performed during a 48-hour closure of traffic operations. During this period track was removed, all rock was broken, excavated and removed, and new track laid. Work was carried out simultaneously in both tunnels. Adequate planning, including contingency plans, ensured that all work was completed during the allotted period. The total cost of the exercise was $A1,500,000.

D. A complete program of measurement and checking of all trackside structures on the route was necessary to identify and relocate all other structures (e.g. signalling equipment) which did not provide adequate clearances from the electric wires.

E. An additional requirement for an electric railway is the necessity to provide barriers to prevent the general public from possible approach to or contact with the electrical equipment. Non-climbable barriers were required to be provided in front of the railings on overhead bridges.

F. Finally, strengthening works were necessary to the deck systems of a limited number of bridges to carry the electric locomotives.

Stage 4 was completed at the end of June, 1989.



TYPICAL BRIDGE PIER
QUEENSLAND RAILWAYS

General Notes on Bridges

As quoted previously, Queensland Railway is currently committed to the use of prestressed concrete as its main bridge building material.

As most bridges fall into the small to medium span category, it has been possible to achieve a high degree of standardization of design. The three most commonly used span lengths at present are 10 meters, 15 meters, and 25 meters. Of these, the 15 meter span is the most commonly used.

The 15 and 25 meter spans consist of Tee beams with a minimum of insitu concrete. This configuration provides an efficient cross section without the construction difficulties associated with the inclusion of voids as required in box sections. Furthermore, as many of our bridges are constructed in isolated areas where there are limited resources (both material and human) greater control over quality can be achieved compared with systems such as I-beams with insitu deck slabs requiring substantial on site concrete.

The ten meter span does however comprise box girders. The voids in girders of this size are smaller and easier to control, and, as these short spans are often employed in situations where vertical clearance is at a premium, the box section allows for a small depth of span.

Other spans are used from time to time to suit special situations. In particular, half-through prestressed concrete spans have been designed for rail over road bridges in urban areas to provide clearances for road traffic.

Standardization has also been carried through into bridge piers, particularly those over watercourses.

Conclusion

Queensland Railways has now progressed to a situation which would have been unthinkable 30 years ago.

It had always been assumed previously that the supposed inherent limitations of a narrow gauge railway would severely restrict its potential. However, the challenge of heavy haul has been met head on by Queensland Railways, and the perceived shortcomings of a narrow gauge system have proven to be largely illusory.

We are not likely ever to carry wagons of the mass of those on many American heavy haul lines or those of the Western Australian iron ore railways (e. g., Mt. Newman railroad is now actively considering 40 ton axle loads), but we are continuing to meet the ever-increasing task confronting us.

The fact that the Fourth International Heavy Haul Conference is being held in Brisbane from September 11 through 16 this year is a testament to our success in this field. Thank you. (Applause)

President Matte: Thank you, gentlemen, for all those fine presentations this morning. Before we adjourn for today I would like to ask you all to pick up a special committee report sheet. Roadmasters is orange and B&B is blue. Fill it out and turn it in to the registration desk. These special subject forms will be the basis for next year's program.

The afternoon is free for the viewing of the REMSA 89 exhibits. So enjoy yourselves, and we will meet here tomorrow morning at 8:30.

This session is now adjourned.

TUESDAY MORNING JOINT SESSION

August 29, 1989

President Tallent: Will everyone please be seated. Good morning ladies and gentlemen. The second joint session of the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association of America will now come to order.

Ladies and gentlemen, members, and guests, on behalf of the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association of America, I welcome you to the second joint session of this conference here in Toronto.

The registration as of this morning was 536 Roadmasters, 104 B&B, 536 Associates, 832 Guests, 468 ladies registered, for a grand total of 2,467. This is a favorable representation comparable to what we had at the last equipment show in Dallas.

At this time it is my pleasure to introduce Mr. Edward B. Burwell, executive vice president of operations of the Norfolk Southern Corporation. A native of Covington, Virginia, Mr. Burwell graduated from Virginia Military Institute with a Bachelor of Science Degree in civil engineering and served during the Korean Conflict as an officer with the U. S. Army's Infantry Division.

He joined Southern Railway in 1952 as a student apprentice at Knoxville, Tennessee, and rose through the ranks to become division superintendent at Birmingham, Alabama, in 1960. He also served as superintendent at Hattisburg, Mississippi, and Knoxville, Tennessee, before being named general manager western lines in 1970.

In November, 1978, Mr. Burwell was named vice president transportation and was elected executive vice president operations on December 1, 1980. He became president of Southern Railway on June 1, 1982, and served in that capacity until moving to the Norfolk Southern. Mr. Burwell became executive vice president operations of Norfolk Southern Corporation on January 1, 1987. Please join me in welcoming Mr. Burwell.

KEYNOTE ADDRESS

Mr. E. B. Burwell

Executive Vice President Operations
Norfolk Southern Corporation

Edward B. Burwell

Thank you, Ray. First I want to say that I did not arrange for that wakeup call this morning (Laughter) at ten minutes to six. I set my alarm on the television for six o'clock last night when I turned in, and when that darn fire alarm went off I thought it was the loudest alarm clock I had ever heard in a hotel room. (Laughter) As I rushed to get it turned off before it woke everyone up I did a little damage to the room before it dawned on me it was a fire alarm. (Laughter)

But it is, ladies and gentlemen, an honor and a privilege to have the opportunity to talk with a group of railroaders who have the responsibility of maintaining our rail infrastructure. I started reading about infrastructure here three or four months ago, and I said, "I want to look that up and see what it means." So I pulled out Webster's Dictionary and Webster defines infrastructure as "the underlying foundation or basic framework as of a system or organization". While we're talking about words, does anybody in here know what the Indian word Toronto means? Well, I picked up another little bit of information, and this is going to be in my educational discussion this morning. Toronto is an Indian word for meeting place which is very interesting considering that's why we are all here.

In any event, in connection with infrastructure, we are hearing a lot of concern in recent months about the state of America's transportation infrastructure. There's a lot of noise coming out of Washington about infrastructure. We have a new transportation secretary, Mr. Samuel Skinner, and he has been talking about our infrastructure and how it is deteriorating. He's been quoted as saying our airports are over used, our highways and bridges are crumbling, subway lines and sewer lines in some of our northeastern cities are beyond their reasonable life span. And he set out to create something we have never had in the United States, a transportation policy. Of course, I wish him the very best, because he's about to set out on a long, hard journey. And I think from all you read and hear that we do have sort of a mess on our hands. It's been reported that 60 percent of the U. S. highway mileage needs some form of surface repair. I can testify about the seven miles I drive every morning and say that it is in need of surface repair.

It is stated that more than 40 percent of the highway bridges over 20 feet long are either structurally deficient or functionally obsolete. One source, the American General Contractors, have reported that rebuilding our highways and bridges to meet today's demands is going to cost about two trillion dollars. Now that's a sum of money that I have a hard time comprehending. It's a little bigger than the sums that I deal with every day. I'm not sure just where all that money is coming from.

In all these discussions, though, about transportation infrastructure, you read very little about the rail infrastructure. When you do read

about it it's in the context of passenger transport, and that's good for our industry. Good because our rail infrastructure, by and large, is in pretty good shape. Recently one of the financial analysts published an article that expressed some concern that several of the railroads are getting into deep debt which could affect their ability to meet needed capital spending requirements in the future. On the whole, however, the rail infrastructure doesn't get a lot of attention in discussions of public policy and there's a reason for that. The answer is the difference between public policy and private enterprise. Now you remember about ten years ago, the rail infrastructure was in pretty bad shape. A substantial portion of track mileage in the U. S. was in a permanent state of slow order. Track deterioration was so bad that cars were derailing without even being in motion. It happened so often that the phenomenon was given a name: a standing derailment. (Laughter)

What changed all that? Again, it's the difference between public policy and private enterprise. Back then the rail infrastructure was shaped by an antiquated public policy. The industry's regulatory strait jacket was so binding that many railroads could not make enough money or attract enough capital to maintain their physical plant at a minimum standard. Public policy often required railroads to hang on to money-losing lines, and there was little incentive for capital spending, because there was so little rate of return. All that, of course, changed with the Staggers Act. Railroads became almost full-fledged members of the private sector, and I say almost because we're still not treated completely like private industry. With more freedom to set rates and service levels, and freed of the burden to maintain unproductive tracks, the industry set about rebuilding tracks and bridges. Public policy tends to be shortsighted. Too many decisions are based on political expediency rather than economic reality. It should be no surprise then that some of the most promising proposals for rebuilding our transportation infrastructure involves a partnership with private enterprise, such as toll roads and toll bridges. We often complain, in the railroad industry, that competition doesn't pay its fair share, and that the taxpayers are subsidizing motor carriers and inland barge transportation. But I hope it's never understood that we envy them this subsidy. We are fortunate in that we alone are responsible for our own infrastructure. Having to bear the full cost of it puts us at a cost disadvantage but in the long run it's a small price to pay for freedom from the whims of public policy.

You, who are responsible for the physical plant, don't have an easy task. The industry is certainly much better off than it was 13 years ago when we were having the standing derailments, but I doubt there's any officer in this room who gets a capital budget that he thinks is big enough. (Laughter) You are constantly looking for ways to lower costs or at least to keep costs from rising. Sometimes I get tired of the word productivity, but it's the only word we have for something that we have to think about every day. Unfortunately, in an old matured industry like the railroad business, major productivity improvements are hard to come by. Most of these improvements come in small increments. But over a period of time these small increments add up, and the accumulation makes the difference between success and failure. We all know that these increments don't just happen. They have to be nurtured, cultivated. We must stay in close touch with our suppliers. We have to keep a dialogue going with those people. That's how most equipment improvements are inspired. Internally, there must be a fertile environment for incremental improvements. Employees, no matter where they work or what they do, must feel welcome to make suggestions. Not only must you involve them and encourage them to speak, but you must listen to what they have to say. Sometimes they won't make any sense. Sometimes we're all subject to that. You don't always have to implement their suggestions, but you do have to respect their opinions and self-esteem. Some good ideas that came from our people include an anchor spreader and spike cleaning machine that we designed and built ourselves. Innovations like this have contributed to keeping our average cost of installation per tie constant for the last four years, even as inflation and wages have risen. Our labor costs by itself per tie installation have dropped 29 percent as a result of incremental productivity improvements. Labor cost per mile of rail laid is down 20 percent over that same period. For surfacing track, labor cost per mile is down 12 percent.

You who are responsible for the physical

plant make difficult choices about the allocation of finite resources. Putting a budget together is something like juggling. A juggler has only two hands and keeps several objects in the air at once. You have only so much money to keep a lot of projects going. You have to take into account another factor, however. The constant shifts of market demands and how they'll shift in the future. It's something like juggling styrofoam balls in a high wind. You have to be alert to every shift in wind direction and velocity.

In the days of regulation we didn't worry so much about market conditions. We maintained our roads, or tried to maintain them, wherever public policy made us go. Now we have to be very market sensitive. If we're not market sensitive we'll find that we've spent a lot of money on a bridge that's going to be there for 100 years when five years later that line is a candidate for abandonment.

At Norfolk Southern the operations division works closely with marketing and corporate development. We submit our capital projects to corporate development who then ranks them into three categories. They look at the future of various lines, they look at our capital budget, and they come back to us with each one of the proposals rated. Category A, of course, is usually the core system, and it gets top priority. The B category is questionable. Usually on the lines in those categories we find that the traffic is declining, and we're not sure what's going to happen in the next few years. Category C lines are those which are candidates for sale or abandonment. Arriving at these categories requires a lot of market research, something that the operating division is not equipped to do. But our marketing and corporate development people have the information necessary to help us make good decisions. Currently, intermodalism is causing the biggest shifts in capital spending. We're increasing clearances to accommodate double stacks. We're doing this by lowering tracks, raising overhead obstructions, or modifying the bracing of through truss bridges. All of this spending is market driven. One of our routes between Kansas City and Buffalo is ideal for double stacks. We have our problem, though, out of Hannibal, Missouri, Mark Twain's hometown, where this particular line crosses the Mississippi River. That bridge has a swing span that was built when Mark Twain was still alive and it has to be replaced. Down on the Tennessee River on an abandoned line in Alabama, we have a bridge that has one modern component, a 1600 foot iron deck truss that was built in 1962, and it is upgradable. We plan to float it up to Hannibal and replace the old swing span with it. I think this is a good example of a market driven requirement being met by innovative thinking and planning, of putting an unused, valuable asset to productive use.

Finally, or perhaps I should say firstly, you who are responsible for the physical plant should keep quality and safety foremost in all of these considerations. I never make a talk that I don't get on the subject of safety, and there's a reason for it. On Norfolk Southern, safety is our number one priority. If we are bringing maintenance-of-way costs to record lows, taking traffic from the highway in record tonnages, and reaping record revenues but doing it all at the expense of the employee's safety, we will deserve what we get in the long run. Such a short-sighted, not to mention inhumane, approach to efficiency is bound to backfire in increased medical costs, lost manhours, falling employee morale, and weakening customer confidence.

We have created an executive safety steering committee comprised of top management people from all of the operational areas, labor relations, casualty and loss protection, medical services, and, of course, our safety department. This committee serves as a communications channel between our local safety committees and top operating management. The steering committee reviews the quality of safety programs. We review goals and results and identify problems. We look at safety meetings, safety audits, and progress made in correcting unsafe acts and conditions. We have decided to take a zero defect approach to our safety program and are guided by six basic tenets:

1. All injuries can be prevented.
2. All exposures can be safe guarded.
3. Supervision is responsible for prevention of injuries and accidents.
4 Training is essential for good safety performance.
5. Safety is a condition of employment.
6. Safety is good business.

We have an action plan for safety of operations and we urge every operational employee to become intimately familiar with it, to pull

it out and read through it on a regular basis. We have also trained all of our supervisors in how to perform a safety audit that focuses on employee work practices. In the past, most of the emphasis has been on work place conditions. This new approach recognizes that people not places, cause accidents. Our overall safety record over the past eight or ten years has been improving annually. In fact, the number of personal injuries has been declining for some time along with the number of employees that we have. Injuries per employee has been declining. And you would think that with that we would be in pretty good shape and wouldn't be too excited about safety. Unfortunately, the bad news is our employee injury costs have soared in recent years. Last year in 1988, we paid out over $100 million to employees who suffered personal injuries on the job. After payroll expenses, that figure is second only to our annual fuel cost, and I don't believe this trend is confined to just the Norfolk Southern property. Some projections that some of our people have made, indicate that if we don't reverse that trend, all of us in the rail industry some years down the road will be devoting all of our efforts toward paying off our casualty claims.

What's the reason for this? One reason is FELA. The Federal Employers Liability Act. Earlier I said that we were almost treated like full-fledged corporate citizens but not quite, and FELA is one reason that we are somewhat behind the rest of the industries in the United States. Those who support FELA argue that without it safety conditions would deteriorate. Management, they say, would have less incentive to maintain the high safety standards. But the fact is, there is less incentive under FELA than there is under the no-fault workers' compensation programs that cover almost all other employees in America. Under FELA, which is an old statute that has been on the books for 50 years or longer, the company is liable only for the negligence of its officers and agents. It is not liable for injuries caused by employees' own mistakes. The employee must prove the railroad was at fault. Under Workers' Compensation the company is liable for all injuries on the job no matter who caused them. That alone is a stronger incentive to provide safe working conditions. For railroads FELA is very costly. As I said earlier, it cost us almost $100 million last year, and I've seen in the paper in recent months or over last year, where other roads are increasing their accruals for casualty claims. So I'm sure that every railroad in the country is faced with the same problem.

From the average employee's perspective, it's a real gamble. To collect, employees must sue and yes, when they do sue, some of them get very generous and sometimes outrageous awards. But some others get nothing. It all depends on the whim of the jury and the expertise of the lawyer they pay. FELA discourages rehabilitation because trial lawyers know a jury will be more sympathetic if the victim remains disabled. This is counter to the best interests of the employee as well as the company. Workers' Compensation, on the other hand, requires injured employees be rehabilitated.

But our incentive to maintain the highest safety standards at Norfolk Southern has nothing at all to do with how employees are compensated for injuries. As I said, safety is good business. To compete we must deliver the goods on time and in one piece. Every accident slows our service down and drives our costs up. Besides the cost of compensating employees, repairing damaged track and equipment, compensating shippers for damaged lading, and compensating third parties injured by accidents gives railroads more than enough reason to invest heavily in safety.

Safety, then, is a separate issue entirely. A vital issue. The number one issue in our operations division. The economic reasons for maintaining the highest safety standards provide ample incentive, but my personal commitment to safety goes far beyond that. It has to do with the human cost of injury, the pain and loss suffered by victims and their families. As long as accidents are preventable we're not going to spare any effort to prevent them. So cost control, wise use of limited resources, safety — these to me are the most critical issues in maintaining North America's rail network. It's incumbent upon us individually and collectively to make a contribution to these areas and to make a difference.

You may have heard the story of the man who was walking along the beach after a storm where there were thousands of star fish washed up on the beach and they were dying in the sun. He came across a small boy who was walking

the beach, picking up the star fish one at a time and throwing them back into the sea. The man asked, "Why?" The boy said he was trying to save the star fish. The man said, "But there are thousands of them. With so many dying so fast how can you make a difference?" With that the boy picked up another star fish, threw it into the surf, and said, "I made a difference with that one." There is no step that's too small. Every increment counts. My charge to you this morning is to use these meetings this week to make a difference, however small. Thank you. (Applause)

President Tallent: Thank you, Mr. Burwell. I know you're on a tight schedule, and I thank you for coming down to be with us today. I hope you'll take time to look at some of the exhibits, both upstairs and at the working track.

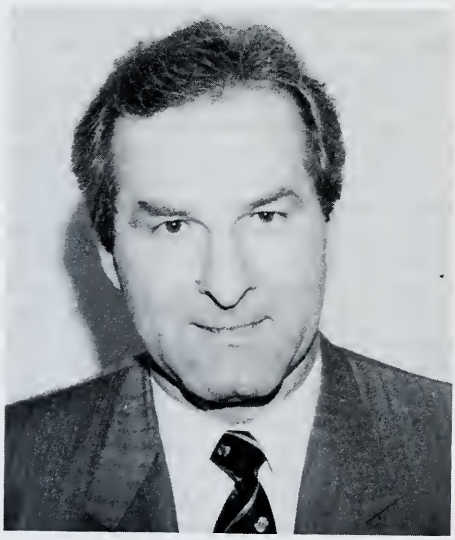
At this time I would like to turn our program over to Mr. Ken Koff who will introduce our next speaker.

Mr. Koff: Thank you, President Tallent. It's my pleasure this morning to present the next subject, "Futuristic Look at the Railroads in the 1990s". The gentleman who will be giving this talk is Mr. Bill Krestinski. He's chief of unit engineering for CP Rail. Mr. Krestinski earned a Bachelor of Science Degree from the University of Saskatchewan in 1966. His entire railroad career spanning 22 years has been spent in service with CP, beginning in 1966 as a junior engineer and advancing to regional engineer in 1987. In 1987 he was appointed chief of unit engineering, his present position. Please welcome Mr. Bill Krestinski.

FUTURISTIC LOOK AT THE RAILROADS IN THE 1990s

W. L. Krestinski

Chief of Unit Engineering
CP Rail



W. L. Krestinski

Good morning, ladies and gentlemen. Welcome to Toronto. I hope that not only do you feel welcome because you are at the conference, but I hope that we extend the same welcome and hospitality to you that you have extended to us Canadians when we've gone to visit your great country.

The assignment given to me by the Association is entitled "Futuristic Look at the Railroads in the 1990s", or, putting it another way, looking back in the year 2000 how will we characterize the last decade?

The agenda for this three day conference indicates that the presentations will be highly technical. My approach today hopefully will be non-technical. I want it to be conceptual. I hope that it's generic in the sense that it's applicable to all railways, and that in some degree it'll be experiencial in the light of the Canadian Pacific.

Emphasis will be two-fold. Yesterday my boss, Mr. Rob Ritchie, emphasized service, touching briefly on maintenance. Today I want to emphasize maintenance, touching briefly on service. The two are so closely connected that to touch one impacts the other. To pursue therefore the matter of track maintenance is

apparent to me that it is no longer a question of how well, or how can, but rather how must track maintenance be carried out in the 1990s.

To rightly appreciate the evolution of track maintenance, we must review the last 30 years. The decade of the 1960s was one of mechanization. It was a decade of my becoming a railroader. The railways moved into the whole area of production gangs. Instead of putting track units in place by hand we converted to mechanization, and we got rid of, to a large degree, the heavy labor intensive functions. The truck sections replaced the old motor car sections, and section limits were extended. People spent more time at their work and less time traveling.

The decade of the 1970s could be characterized as proliferation. That proliferation was in the matter of machines. The ones that were introduced to us in the 1960s were now available to many of the track people. It got so extensive that some of the equipment that was purchased was really not used, because it wasn't used properly. Very often much of it ended up in sidings and back tracks, because either people didn't know how to use it properly, or it was down. The RCO and PA-11 were two large pieces of equipment that came of age in that decade.

The 1980s were the decade of optimization. It was the decade where we experimented with gang consists. We balanced men and equipment. We started reducing our manpower, because the equipment could do work that took many men to do. We were also balancing equipment with equipment, trying to get rid of the slow wheelers. Whether the slow wheeler was a person or a machine, the objective was to get the most done in the time alloted, and track time was a premium.

If the 1960s was a decade of mechanization, 1970s the decade of proliferation, and the 1980s the decade of optimization, then I believe the decade of the 1990s will be one of innovation. Railways are going to have to work differently. They're going to have to work smarter and have to be more creative.

Over the last ten years—and when I talk about engineering I talk about all of the functions that stem from the engineering function, the roadmasters, the B&B, the maintenance-of-way activities, everything that has to do with maintaining the fixed plant. The last ten years have focused on reducing unit cost. After all, the ultimate measure of improvement was to reduce the unit cost. We wanted to obtain large work blocks because we had to get the work done.

The experience of one outstanding railroad a few years ago was to get very large work blocks. We had learned via the grapevine that the cost of installing ties was down to $3.25 or so, and our people had come to Canadian Pacific and said, "Well, why can't we install ties at that price?" We were invited down, and we had a look at the operation, and, in fact, they did put in ties for $3.25. The railroad had a ten hour block; the first hour put them in position; they had about eight clean hours of track time, and the last hour was the wrap up.

But what didn't figure into the cost of installing ties was the price that transportation had to pay while all kinds of traffic was standing by waiting for the work to be done. We didn't criticize that. We just wanted to make sure that we had the right information. Interestingly enough, that same railway, and it was an outstanding railway, you may know the one I'm speaking about, the next year decided, I guess, that the cost was too high to pay, and they've switched to almost the opposite extreme to install ties with detractable equipment. So, in the 1980s we focused on the matter of reducing unit costs and obtaining work blocks. We also wanted to improve total production. In Canada we have a particular problem. We can't do our work for 12 months of the year. By the time the middle of October or November rolls around, at least in the north country, we have to wind things down because of the winter time, and so we have a problem making sure we can get the whole of the project completed quite apart from the unit cost. Of course, management had also figured out a way to do the same amount of work with less dollars or do more work with the same dollars, and they asked us to eat inflation year after year.

While we were occupied with all these good things we had forgotten that the reason for our being in business was to satisfy the customer. As engineers we got the dollars we had so skillfully argued for, and with some tunnel vision we set about to do the task. Toward the end of the 1980s the situation became even more complicated. The deregulation, or more accurately I think, the reregulation of the transportation industry in Canada in January, 1988, and

the Canadian-U.S. free trade agreement in January, 1989, put much of the traffic heretofore captive to one's own road open to predators, other operators, including trucks. It is my conviction, therefore, if railways are to be a viable business enterprise, engineering considerations must concentrate on the following:

- Satisfy customer demand for service
- Explore equipment capability
- Experience change in attitude
- Cultivate improved communications
- Challenge the supply industry, particularly, to creativity

We will touch briefly on each.

First consideration, therefore, is to satisfy customer demand for service. How do you do that, you might ask. Well, the bottom line is to make sure that the goods arrive to the customer's schedule. The railways have a history of telling the customer what's good for him, and that has to stop.

But there are impediments to achieving that: diesel power shortage either caused by equipment failure or an absolute shortage of power; train crew addicts; either the radio is working or the caboose isn't very clean. Of course, we hope to lick that problem pretty soon. Lunch breaks have to be taken. Another big impediment is the matter of slow orders, and we'll look into that in more detail. Either the plant condition or the work programs precipitate slow orders, and that affects our ability to deliver the goods on time. Track occupancy— where we plan our work, we plan to delay certain trains. All of these factors cause delays resulting in either missed connections or misplacements.

The problem in the 1980s was also one of incompatible objectives. Transportation people were charged with getting the trains to destination on time. Of course, the engineering people kept on wanting to reduce the unit costs. A good example of that for me is two fellows, one who has a marble bag with seven marbles in it, and both fellows want to get four of them. Of course, that's impossible. It's a nice objective, but very often at the risk of injuring the other party. This predicament spawned for Canadian Pacific, the WPI, or the Work Program Initiative, and that was inaugurated in June, 1988, on my particular unit which is headquartered in Toronto.

Let me explain a little bit what the Work Program Initiative is. I remember talking to a division engineer one time who had been at a derailment where they had replaced a bridge and he had been out on the road for about 10 or 11 days. Coming back to the office on a Friday night he saw a pile of paper about a foot high on his desk, and he decided that he wouldn't come in on Saturday morning. That's the great catch-up morning for you railroaders, as I'm sure you know and most of you do. But having a good night's sleep on Friday night he decided he would go in. So sitting at his desk he saw that right on top of the pile was a foldout, and he opened it up, and there was a note from his superintendent, who said, "Mr. Division Engineer: Please enable me to reply." And what he was asked to reply to was this: there had been a great debate on the uniform of the baggagemen on the passenger trains. He had asked the division engineer what kind of uniforms should be supplied to the baggagemen. Well, the division engineer thought of his 11 days in the mud, and he turned the folder over and wrote back to his superintendent and he said, "As far as I'm concerned you can dress them all in overalls." Well, needless to say his superintendent wasn't impressed, and they didn't speak for a while. And I wonder if anyone asked the baggagemen what kind of uniforms that they should be wearing?

So taking the lead from that kind of example and the problems that we were having we had initiated some brainstorming workshops. We wanted to generate some ideas and talk to some people so we talked to the rail, ballast, tie, surfacing, welding gangs, involving gang supervisors, technicians and foremen, train dispatchers, roadmasters, assistant superintendents. We talked to a line division, to a terminal division. We talked to unit engineering people, mechanical and transportation folks. It was amazing the ideas that flowed from those sessions. A hundred ideas were generated over the two-week period that the sessions were held. Forty-one were dropped because some were duplicates. Some were not cost effective, and some were not workable. Those were recognized immediately. Sixteen of them were detailed studies and they were set back because they would take from six to 12 months to investigate. Fourteen were deferred to be considered later. Twenty-one were fast studies which could be implemented in two or three months with some experimentation to determine

effectiveness, and eight were quick moves which could be incorporated quickly in a day or two or in less than a week or two.

It would be great if you could do all your work in daytime but one of the problems was that, in fact, adequate daylight work blocks were not available for ballasting operations. One of the ideas was that we should not do our ballasting in the daytime but do it at night. We hadn't yet perfected the double tracking, as you see it there. We've been involved in vertical flyunders of a permanent nature but that's a little down the road. So idea No. 55 was to do the work at night when the required block is available. It's no longer a question of getting sufficient hours to do the work because they just were not available in the daytime. The idea was radical. Supervisors were not sure of success, and earlier attempts had been unsatisfactory. We had some derailments, and we just had steered clear of trying to work at night. The night work experiment involved lighting; insects were an ever-present company. Mosquitoes were so large that you could recognize them when they came back for seconds. (Laughter) Safety was and is important. We had to pay a wage premium for night work. Labor Relations got into the act potentially to smooth any waves that might arise from the organization. Routines were upset. Can you imagine having breakfast at 11 o'clock and going to work at 30 minutes after midnight, working through to about eight o'clock, and then having supper and going to bed? How would you keep track of men at night, and how effective would the supervision be?

The next series of slides, although they don't cover the ballast gang simply because I was too slow to be able to capture them this year, show the rail operation, laying CWR this year, and you can pretend you are looking at ballasting. But the situation is in the same territory, and we have done both of those operations this year at night.

If you can't see very much it's because you can't see very much when you start out! (Laughter) You have to make sure that the powerhouse has lighting and that the attendant equipment is also properly illuminated. The support equipment, individual machines, also have to have lighting. Of course, the men have to have some light. You can see there is, while the work station is lit up by the flash of the photographer, sufficient lighting to enable the unit operator to do his job, and that there is enough light to do maintenance.

As we work out into the morning, the dependence on artificial light is reduced. The check of the joints, which in due course will be thermite welded, is found to be satisfactory. You can see the eastern sky lighting up. So we move ourselves right into the daytime.

One result of the experiment — while we were amazed there wasn't a murmur from the organization of the men, we thought that injuries might be a problem. We had one injury, but it happened in the daylight. A chap tripped over a cable. Production rate was within one-hundredth of a mile of the daytime operation, and what is significant is that you wouldn't get the time to do the work, let alone the productivity, if you tried to do that work in the daytime. This is a calculation based on the long-term operation in the north country. Cooler nights enabled us to work without the problems of buckled track. We didn't lose any men and the bugs had all they could eat! (Laughter)

What do we do with the idea? Well, where daylight work blocks are not available we work nights. This year we've laid rail. We have ballasted. In the area of ballasting we've had an undercutting operation. We surface at night. We pick up our rail at night, and we thermite weld at night. Well, every initiative should be evaluated and we did that. We evaluated the train performance and the gang performance which are the two most significant indicators of how successful the operation was.

Let's look at the train performance. This is a graph that on the Y axis shows the percentage of trains arriving at destination on time. Along the bottom you'll see the time line, November 1987 through November 1988. We historically had started out in the fall of the year in the 40 percent range. Then when we got over here to April and May when the work program would start, we would, in fact, follow that down, and we'd languish all the way through the summer until about October, then we'd come back up to about 40 percent.

Well interestingly enough, when we inaugurated the work program initiative in June we had a couple of spikes. You can see the trend, which is the green line. It was very gratifying to know that in fact, not only were we able to do the work that we wanted to do on the track,

but we were able to improve the performance of the trains. Those were westbound, the four hotshots that we captured in that survey. This graph shows four eastbounds, our hotshot eastbounds, and they also used to languish around 40 percent. We have a better performance there. You'll see it runs around 80 percent. So, we were satisfied that the train performance and our customers were being well served.

But what about the gang performance? I have four slides to indicate that just very briefly, we won't go into much detail. The yellow bar indicates the planned unit cost, the green bar the actual unit cost. The ballast gang was slightly over on average but we were able to complete the program, which is significant. The two sub-divisions that gave us the most problems were the White River and the Namegest, the two interior bars. It's always tough to work there, and it's just absolutely impossible to get a daytime block that is satisfactory. Our spread on actual plan and cost was also rather significant, but again we completed the program.

Regarding the tie gang, you'll see the first three gangs were on or better than plan. The second gang being just a little over gang No. 4, probably shouldn't have been included here, because we were putting some safety ties in a branch line, but we rolled them all in together for this particular demonstration slide.

Surfacing gangs are also reflected there. We beat the plan by a satisfactory margin. Again, a couple of sub-divisions gave us difficulty, but we were able to complete the program. The significance of all of those charts is that if we were expecting to do all of our work in the daytime and were confined to the daytime, we either wouldn't get the programs done, or we'd go into the fall so late that we would run the risk of not only overshooting our costs by a great deal but do damage to equipment. And we like to wrap things up fairly early, and get the equipment back into the shops so that those can properly be overhauled.

The interesting thing about all the program initiative is when you look at the impact that maintenance-of-way activities has on the total variance. The total variance is defined as the actual run time of all the trains between May 1 and October 27 on a particular division of ours in the north country less the theoretical transit time at timetable speeds. We would take the total run times of every train, and then we calculated the theoretical run time that the train would take observing the permanent slow orders in the time card. You can see that that number of hours totaled 6,877 for that period. A full 25 percent was due to temporary slow orders. All others, none of which exceeded two percent, make up to 24 percent. The authorized work gangs were authorized to use ten percent. Meets: because sidings were out of service, the OOS, amounted to four percent. Unknowns amounted to three percent. Work gangs that violated or exceeded their authorized time are represented with three percent. Meets caused by passenger trains were nine percent, and meets by freights were 22 percent. So if you'll amalgamate the times that are effected in some way or precipitated by maintenance-of-way activities, the total is 42 percent. Now this initiative which started in June, 1988, is not dead now that 1988 is gone and 1989 is upon us. It's a dynamic tool. It's going to be used ongoing. The interesting thing about this work program initiative was touched on by a previous speaker when he said that you have to talk to your people. After we had visited the gang, one of the supervisors said, "If you go back home and trash my idea I will consider it a worthwhile exercise, because you came and talked to us." And I think we have to do more of that, and we're convinced that that's the way we have to go.

So if the consideration to satisfy customer demand is paramount, the other consideration is that we must explore equipment capability. We have a range of options. We can go all manual with no mechanization like this cartoon illustrates. One thing about that operation is those fellows can step clear of the track when they hear the whistle. They don't need much of a block of time. The fact of the matter is we can't do all of our work that way. We need to be fully mechanized in some of the operations, and then there's an area in between both where we have to be able to get equipment that can get on the track and get off the track at the work site and do both of those functions efficiently. We now can surface, or we used to be able to surface, and install ties, and install rail with virtually no mechanization at all. Of course, we've done a turn around on that where the equipment consists virtually have to run to sidings to clear the way and we have to move in that direction as quickly as we can.

Not only do we have to satisfy customer demands for service and explore equipment capability, but we have to experience the change in attitudes. No longer is it engineering versus transportation. It can't be us versus them, or we versus they. It's refreshing to have a chief of transportation come to the engineering people and say, "We had a great day with the gangs yesterday". Or have a supervisor maintenance-of-way chew out a gang supervisor because he violated his work block. That happened not very many years ago in our company and may have happened in yours as well. But rather, it has to be a case of our, our whatever, whether it be senior management or marketing and sales or operations or maintenance, be it division, region, district, unit, area, however you happened to be organized. The gang supervisors and the scheduled employees. The scheduled employees are going to be the most difficult, I think, to bring on board, because there's some skepticism as far as the direction that the company is headed. Also bring in department heads in engineering, transportation and mechanical. It's no longer that we have fragmented responsibility, but we must have cooperative ownership of the operation. So to satisfy customer demand for service, we explore equipment capability and experience a change in attitudes and we must cultivate improved communications. An amazing paradox with the railway industry is that we have the best tools to communicate, but often we do the poorest job in using them.

The emphasis that I'd like to stress today is two-fold. One is to accommodate the dynamics of the industry. By that I mean the plans that we set today will not likely come to fruition necessarily because of all the things that happen during the year, and we must share information with our customers. Derailments either on your own territory or adjacent territory due to plant failure or acts of God, will upset the work programs. It may help one but it will be a disadvantage to another. Train delays awaiting traffic or traffic offered, or equipment failure is dynamic. Our mechanical friends can't ensure that the power is always going to be available, and therefore, that's another impediment. There are revisions to the work plans because there are budget considerations. Materials aren't always supplied or labor is short and all of these things indicate to us that we have to be flexible and nimble, and that the industry of railway is dynamic. We have to keep the customer in the know. He may not be impressed by the reasons for the delay, but he has to know about them, and he has to know why. There has to be a plan of action where it's necessary. It's no longer satisfactory to say that the customer hasn't complained, so I guess our service is okay. We have to move to a position where the customer said or wrote saying that he is elated with the service. The latter is the only sure barometer of how well we're meeting the needs of the customer. The final consideration after we have satisfied customer demand for service, explored the equipment capability, had a change in attitudes and cultivated improved communications, is the challenge to the supply industry to creativity. In maintenance operations we need long work blocks for large and heavy machines. We can't do our ballasting with detractable or non-mechanization. Our surfacing can't be done that way either. You can't install concrete ties with light equipment, so we're going to have to live with large and heavy machines and long work blocks. We can, though, live with short work blocks using small light machines for laying rail, installing wood ties, and other functions. So we ask ourselves what of the success of the supply industry meeting the needs? Well, I think the success has been good in the area of large heavy machines requiring long work blocks, but it has been poor in the small light machine area where long work blocks are not available.

So I want to challenge the supply industry today to focus your attention and energy on detractable equipment. We have to be able to mount the track efficiently and do good work and also get off the track efficiently. I think the verdict to date is that there is really no equipment consist that satisfies the stated criteria. Examination of detracting equipment today would probably not get a passing grade. Somebody has defined a leader as one who finds out which way the pack is headed and then gets out in front as fast as he can. (Laughter) Well, we don't want to be those kinds of leaders. As engineering people in the generic sense then, and if you're in this room today and you're a roadmaster or B&B master, supervisor of gangs, or departments, or a supplier, then you fit into the category when I say that we have no job in our particular field of endeavor

except to eliminate the impediments to getting the goods of our customer to dock on time. I think if you think otherwise you probably have to have a talk with your boss, because you may be involved in all kinds of support activities, but ultimately your purpose and mine is to take the goods of customer A from here and move them to wherever he wants them to his schedule. I don't know what you had in mind when you came to today's presentation. The scope of the topic was so broad, but I wanted to share with you the kinds of things that we have on CP. I know that we're not different from you in the sense of objectives so that I could communicate to the industry and to our own people that some of us have to turn our attention a little more to the matter of meeting the needs of the customer as he defines them. We want to be leaders in our own field and you as suppliers. We in the industry are grateful today because of the exhibition here this week. If we can communicate this kind of message to you it will not have been a waste of time. Thank you very much. (Applause)

President Tallent: Thank you, Mr. Krestinski. This ends our joint session for today, and we're going to take a short recess. The Roadmasters will reconvene back in this room at 10:00. The B&B Association will meet across the hall in Room 104 C and D at 10:00.

Recess

BRIDGE & BUILDING SESSION

Tuesday Morning — 10:00 A.M.

President Tallent: Good morning. The B&B session is now called to order. As usual, Pat in her efficient ways, called the Royal York this morning at 10 minutes to six and said there was a fire, (Laughter) so we would all be up! (Laughter) Pat is not staying at the Royal York as you know.

The last year has been a very interesting and gratifying year for me. The attendance figures Pat just gave me are very gratifying. We have now exceeded the total number of people that we had in Dallas, the last equipment show. We have 553 Roadmasters, 106 B&B, 547 Associates, 833 guests, for a total of 2,029, with 472 ladies, which gives us over 2500. So we have exceeded Dallas, which was the most successful show in recent years. I'll take credit for that! (Laughter)

Being president this year, meeting the people, going around the country for our meetings, listening to Pat beat me on the head, and changing jobs and moving has been hectic, but it has been enjoyable. And the reason it's been enjoyable is the people I'm looking at here. The response we got, the program we planned, everything has been very successful, and it's the quality of the people who are out here, and the quality of the people on the board, and the people that we have in the office that makes it that way. Byron is going to be taking this job tomorrow, and we have a good foundation for him. Pat has been training him so he will fill in well. (Laughter)

I'd like to call on immediate past president, Don Lewis, at this time to introduce all the past presidents here today. Don.

Mr. Lewis: Thank you, Ray. Before I introduce the past presidents I would like to acknowledge two things. I don't know if these individuals want it known or not, but we have a special day today for two individuals. It's their birthdays. Jim Budzileni and President Tallent. (Applause)

Now, I'd like to introduce the past presidents and I feel honored to be in that group. I ask that each come up to the podium as they're introduced so that we can get a picture. W. C. (Wally) Sturm, senior project engineer, Elgin, Joliet and Eastern Railway, President 1978-1979; W. R. (Walt) Hyma, bridge engineer structures (retired), Atchison, Topeka and Santa Fe Railway, President 1981-1982; Jim Budzileni, senior structural designer (retired), Illinois Central Railroad, President 1983-1984; J. M. (Jim) Williams, supervisor B&B (retired), Elgin, Joliet and Eastern Railway, President 1984-1985; J. T. (John) Kapp, project manager construction, Conrail, President 1986-1987; and myself. Thank you. (Applause)

President Tallent: Thank you, Don. On behalf of the Association I want to thank all the past presidents for being present. I'm glad Don, John Kapp, and Wally were all there because I thought you might have to retire after you leave this job. (Laughter) But the past presidents have all served us well and some are still working with us and hopefully in 1991 in St. Louis when we have our 100th anniversary we'll have even more of the past presidents with us.

I would like to ask Don, as past president and chairman of the Nominating Committee, to present the slate of officers for the upcoming year.

Past Presidents from left to right: W. C. Sturm, W. R. Hyma, J. Budzileni, J. M. Williams, J. T. Kapp, D. J. Lewis.

NOMINATING COMMITTEE

Mr. Lewis: Thank you, President Tallent. The nominees are as follows: for President, Byron T. Burns, structure engineer, Atchison, Topeka and Santa Fe Railway; for Senior Vice President, John J. Horney, construction engineer bridges, Union Pacific Railroad; for Junior Vice Presidents, Mark C. Walbrun, project manager, Amtrak, and Paul H. Saletnik, engineer of buildings, Chicago and North Western Transportation Company. For Directors whose term will expire in 1992: Doug G. DeBerg, engineer rail-field, Atchison, Topeka and Santa Fe Railway; Donald F. Sorgenfrei, associate, Modjeski and Masters; Joseph A. Lileikis, systems manager structures, Union Pacific Railroad. To fill an unexpired term of two years, we have Robert W. Carter, general B&B supervisor, Burlington Northern Railroad. That is the slate of nominees. Thank you gentlemen.

President Tallent: Thank you, Don. You have heard the slate of nominees recommended by the Nominating Committee. Are there any further nominations from the floor? There being no other nominees, I will accept a motion that the slate submitted by the Nominating Committee be elected. Do I have a motion?

Member: So moved.

President Tallent: Is there a second?

Member: Second.

President Tallent: The motion has been made and seconded that the slate of candidates recommended by the Nominating Committee be elected to the offices specified. All in favor signify by Aye. All those opposed? The ayes have it. I hereby declare these officers duly elected.

We will now proceed with our Business Session and provide the necessary reports. If there are any questions concerning any one of the reports, I will request that you hold your questions until after the report has been given. Will the Secretary please give the Secretary's Report.

BUSINESS SESSION

SECRETARY'S REPORT

September 1, 1988 Through August 29, 1989

Total members, September 1, 1988		684
New members since September 1		73
Members reinstated since September 1		2
		759
Less: Dropped — Active	29	
Associate	4	
Life	2	
Deceased — Active	3	
Life	5	43
Total members, August 29, 1989		716

President Tallent: The membership report shows a net increase over last year. I challenge everyone to get an application form, buttonhole a prospective new member, and have him fill

out the form and mail it in. We will not have an Audit Report at this time; however, there will be a report in the Proceedings. The auditors usually come in the end of August, but since the meeting was early, this year the audit report won't be done until next month. But the report will be in the Proceedings. At this time I'd like to ask Jim Williams to come forward to give the Treasurer's Report. Jim.

Mr. Williams: We have to wait on the audit to make sure Pat doesn't get her coat out of this trip. (Laughter) (NOTE: Mr. Williams presented Treasurer's Report for period September 1, 1988 through August 5, 1989. Treasurer's Report for period September 1, 1988 through August 31, 1989, along with the Audit Committee's Report, follows.)

TREASURER'S REPORT
September 1, 1988 through August 31, 1989

Checking account balance, September 1, 1988		$ 8,428.95
RECEIPTS		
Dues	$11,744.20	
Advertising — 1987	375.00	
1988	13,760.00	
Interest on checking account	347.39	
1988 Conference proceeds (net)	3,741.20	
Miscellaneous	228.49	
Transfer of funds	3,500.00	33,696.28
		42,125.23
DISBURSEMENTS		
Salaries	$ 8,885.54	
Payroll taxes	819.31	
Office rent, utilities & insurance	1,568.00	
Office supplies	509.25	
Equipment purchase, rent & repair	333.86	
Stationery & printing	1,864.23	
Postage	1,560.00	
1988 Proceedings	10,002.76	
1988 conference expenses	541.14	
1989 conference expenses	271.34	
Executive committee meetings	1,175.13	
Temporary office help	228.24	
Miscellaneous	411.46	
1987 advertising paid to B&B in error	250.00	
1988 advertising	60.00	
Refund of duplicate dues payments	20.00	
Transfer of funds to savings	7,500.00	
Foreign check charges	27.13	36,027.38
Checking account balance, August 31, 1989		$ 6,097.85
Homewood Federal S&L Money Market (8/31/89)	$ 5,878.51	
Homewood Federal S&L Certificate	5,190.72	11,069.23
Total funds, August 31, 1989		$17,167.08

AUDIT COMMITTEE REPORT

To: Members of the American Railway Bridge and Building Association

Gentlemen:

The undersigned have examined the books of the Secretary and report of the Treasurer for the period September 1, 1988, through August 31, 1989, and have found them to be correct as of August 31, 1989.

(signed) J. R. Williams, Chairman
(signed) W. C. Sturm
(signed) J. Budzileni

President Tallent: We are solvent and with the show attendance like it is, the outlook is bright. I'd like to ask Mike Bradley to come forward to present the Necrology Report. Mike.

NECROLOGY REPORT

To the President and members of the American Railway Bridge and Building Association.

It is with grief and regret that we report the known loss of nine members through death during the past year. It is possible that other members have passed away during the year of whom we have no information. If you know of anyone, please report their names to the Secretary. The following have been reported since our last Annual Conference in September, 1988:

H. R. Bowman
Gen. Supv. B&B
BN RR
Joined 3-28-84; Died 12-27-88

R. G. Bradfield
Agreement Engr. (Ret.)
Penn Central
Joined 2-6-57; Died 10-24-88

M. H. Dick
VP/Editor (Ret.)
Railway Track & Structures
Joined 10-1-37; Died 8-12-89

Fred F. Hornig
Div. Engr. (Ret.)
CMStP&P RR
Joined 8-28-47; Died 12-8-88

E. A. Johnson
Engr. Bridges (Ret.)
IC RR
Joined 1-1-53; Died 4-10-89

Joseph J. Sheffield
B&B Supv.
CSX Transportation
Joined 6-6-72; Died 3-4-89

G. P. Slagle
Chf. Carpenter (Ret.)
CMStP&P RR
Joined 9-10-48; Died 12-10-88

B. S. Spencer
Structural Supt.
Ontario Northland Ry
Joined 3-23-65; Died 12-5-88

Howard Warfield, Jr.
Insp.M/W (Ret.)
Pennsylvania RR
Joined 12-8-52; Died 1-7-89

I would like to ask for a moment of silence in honor of our deceased members.

Respectfully submitted,
Mike Bradley, Chairman

President Tallent: Thank you, Mike. Are there any questions concerning the reports you just heard? If there are no questions or discussion, I will request a motion that these reports be approved as given.

Member: So moved.

President Tallent: I have a motion. Can I have a second?

Member: I second.

President Tallent: It has been moved and seconded. All in favor signify by saying Aye. Opposed? The Ayes have it. The motion is carried, and the reports are approved. That concludes the business portion of this sesson. I would like to have Mike Bradley come forward to introduce our first report.

Mr. Bradley: Thank you, President Tallent. Our first presentation will be Special Subject No. 1, entitled Scour Control and Prevention at Bridge Foundations. The chairman for that report is Mr. Joe Lileikis. Joe graduated in 1981 with a Bachelor of Science Degree from the University of Nebraska. Shortly after graduation Joe hired on with the Union Pacific Railroad as a draftsman. In 1984, Joe had a short stint as a structural designer before he went to Portland as a project engineer. In 1986 Joe returned to Omaha as general supervisor B&B. In 1986 he was promoted to assistant manager bridge maintenance and now holds the position of manager structures. Joe.

SPECIAL SUBJECT NO. 1

Scour Control and Prevention at Bridge Foundations

Chairman: J. A. Lileikis, Mgr.Strs., UP, Omaha NE

Vice Chairman: J. L. Neece, B&B Supv., CSX Transp., Helena AL

Committee: K. H. Jennison, Des.Engr., BN, Englewood CO
T. V. Dunn, Br.Engr., C&NW, Chicago IL
A. Burrows, Engr./Diver, Arcata CA
M. C. McMaster, Constr.Engr., Conrail, Canton MI
T. Rich, Asst.Supv.Strs., Conrail, Worthington OH
D. F. Sorgenfrei, Assoc., Modjeski & Masters, New Orleans LA
R. W. Emmerich, Mgr.Engrg., Osmose, Madison WI

Scour-Definition

I'm almost positive that everyone in this room has experienced or detected a condition of erosion caused by the scouring away of materials, but I still feel compelled to define scour. If you were to look up the definition in an engineering textbook, scour could be defined as "the removal and transportation of material from the bed and banks of rivers and streams as a result of the erosive action of running water."

Throughout this presentation, I will attempt to highlight some typical scour problems, how we might be able to detect and anticipate problem areas, and then touch on various corrective measures that are taken by the railroad industry in general protecting against potential failure of a structure.

Scour-Causes and Related Problems

Many things can lead to the scouring away of foundation protection, but in nearly every instance, the presence of water is required. The presence of turbulent, raging waters, however, is not solely responsible for scour. Normally, externally applied elements are needed to add fuel to the fire and create problems. Many of these items such as drift deposits, stream alignment, channel change, and incorrectly placed

riprap can be corrected before too much damage is done.

Items such as additional channel dredging (which commonly occurs in navigable waterways), river current velocity, and initial design faults in pier and abutment placement can be rectified but usually at a greater expense to the bridge owners.

Basically, however, as Tom Collins pointed out in his article in the April 1980 issue of Railway Track and Structures, "scour is caused when the velocity of the channel is great enough to pick up materials from the bottom (of the channel), and transport them downstream. The greater the water velocity, the greater will be the weight of the materials that can be moved." To put this into terms that I can understand, . . .the more water, the faster the water, . . .the bigger the hole.

The most common source of scour, which characteristically associates itself with increased channel velocities, is the change in flow caused by seasonal variations. This type of scour is classified as "local scour" and is most often contained within a certain area. Accelerated flows will have a tendency to produce scour holes. As the water levels subside, these holes tend to refill with sediment material, thus creating a scouring and filling cycle. These normal scouring and filling cycles that occur are not of great concern if no evidence of settlement is present, but the changes in the normal pattern of scour and fill, which tend to accompany large storms, dredging, and channel obstructions such as drift, can pose serious and potentially detrimental problems to structure foundations.

The severity of foundation scour is also dependent upon many factors. Depth of scour, for instance, can increase drastically depending upon the shape of the pier or foundation. Later on in this presentation I will discuss various pier configurations that can be considered during the design phase of new structures, and how anticipated scour lines apply to them. The type of stream bottom material can also dictate scour depth, ranging from near zero scour in hard rock stream beds, to depths greater than 20 feet in unstable, murky river bottoms.

Probably one of the most common causes of foundation scour experienced by a majority of B&B personnel is the accumulation of dirt and debris.

I've often wondered how many farmers had cleared their fields just before the storm hit, because judging from the size of the drift that normally accumulates against the bridge, you would think that the local forest had been washed away. Unfortunately, if the drift is not regularly removed, not only do you have a fire hazard, but large accumulations have a tendency to divert river flow, causing bank erosion, while in many instances simultaneously deflecting the stream and creating additional scour to the foundation piers or piling.

River changes, such as diverting river flows into channels, and sometimes stream realignment, can cause general river scour, which has the tendency to lower the river bed both upstream and downstream, allowing for the potential undermining of pier foundations.

Speaking of undermining foundations, construction of structures within close proximity of existing structures, if not carefully monitored and thought out, will allow even the normal flow of water in a river channel to scour out around existing piling or foundations, which could prove to be a rather costly and embarrassing incident.

Inspection and Early Detection

The early detection of potentially hazardous scour problems is as essential as the initial design of foundations to combat scour problems. The only dilemma, however, is that the early signs are well concealed, since they are typically under water. Problems of undermining foundations and loss of stability are not normally detected until a situation of pier settlement or collapse has occurred, then it could be too late.

Of course, if you have the resources and the money, electronic depth-finding instruments can be used around the pier, when the water is deeper and the current is swift. The depth finders used exclusively for fishing are nearly identical to those that can be used for stream bed plotting.

Lastly, and of course, the most costly, is employing an underwater diver/inspector to survey the structure foundations for scour and the extent of scour. In the past, underwater inspections have found pier footings to be undermined when little or no scour had been expected. Supportive information found during underwater inspections may lead to the

establishment of maintenance programs for concrete jacking of columns or piers, concrete encasement of piles in bents, riprap placement, and the reinforcement of members.

Underwater inspections, as with many other aspects, can range from simple to complex. The simplest form of underwater inspection is what is categorized as a "swim by" type of inspection. Here the diver basically swims by the substructure, and sees the extent of scour, if any, by either a visual or "touchy-feely" method. A second type of underwater inspection takes the swim by and adds cleaning, and some removal of deposits, to obtain a more detailed observation of the amount of scour or deterioration. The final type is what we would call a full-fledged investigation, where samples may be taken for further testing and analysis. Extensive cleaning may occur if materials appear to be decomposed or deteriorated.

Solutions to Scour Problems (Field Related)

Typically, the normal maintenance budget allowed for a supervisor to keep his or her portion of the railroad in an operational state does not allow for the full-fledged repairs or investigations to occur, no matter how necessary they may be. Fortunately, however, there are many effective means of dealing with scour and its prevention that have been proven over the years through actual application. When dealing with embankment erosion there are numerous methods utilized today, which I'm sure most of you have either used yourselves or seen applied, that effectively control the erosion from increasing.

Probably the most common form of embankment protection is the application of riprap to the slopes at or near the bridge ends. A fancier form of riprap placement, that has been growing in popularity over the past few years, is the placement of "sacked concrete riprap" bags which are also known as barrap, sackcrete and probably about at least a dozen other names throughout the country. Considerably more expensive to install than riprap itself, barrap bags can be placed directly in the area where protection is desired without the use of heavy equipment. By driving reinforcing steel into these bags, further protection against potential washout is assured.

When timber structures have been replaced with newer bridges, or rebuilt in kind, the old piling is normally cut off at the ground line. These piling stubs, at or near the bridge ends, make ideal supports for secondary backwalls, with the area between the two backwalls filled in with fill material or riprap.

Other methods of embankment stabilization which have been employed over the years and whose use has somewhat diminished due to the fact that they are labor intensive and costly, is the placement of concrete crib walls, bin-type retaining walls, gabions, and placed and mortared stone or brick.

Another concern, with regard to the integrity of a bridge foundation system that has been scoured away, deals with the loss of piling penetration from this erosion. As you know, the stability of a pile bent is greatly diminished when piling that had 20 feet of cover now only has five. The miraculous cure-all "riprap" is as effective here in providing bent stability as it was in stabilizing bank erosion. Also, it may be noted that, by placement of riprap downstream of a structure in which erosion is beginning, a silting-back-in process will begin and may eliminate the need for future stabilization.

In many instances loss of pile penetration, or pier scour, is not curable by riprap alone. Typical methods of providing stability and a resistance to further scour may involve the collaring of bents, in which concrete is poured around the piling, driving retaining walls around the bent or pier that are made up of either sheet piling or timber and, in some cases, whatever material is available, and filling in the voids between protection and foundation.

If a detailed scour investigation has determined that the amount of scour, loss of penetration, or pier undermining is excessive, normal relatively inexpensive repair measures will not work as effectively, and more elaborate repairs may be in order.

The undermining of pier foundations, or the exposing of pier timber mat foundations to the elements caused by river scour historically lead to repairs that translate to "big bucks". A bridge pier was reported by a train crew to move while under load. Surveyors were sent out to take reading of the pier while under traffic, and a lateral movement of only three-fourths of an inch was detected. An underwater inspection was performed next, and it was determined that the timber mat foundation supporting the

pier was now exposed to the water, allowing for it to fully saturate. Needless to say, one to two inch gaps between the stone pier and the timber mat were discovered allowing for the rubble fill inside the stone pier to wash out. It was decided to drive steel H piling around the pier and encase the entire assembly with a sheet pile enclosure that would double as both formwork for concrete encasement, as well as an inhibitor for further scour. At last report, these repairs will probably exceed $200,000 which, granted, is a great amount of money but peanuts to the cost of replacement of this structure should it fail.

Similar repairs were used on another structure, where the pilings themselves were found to have been scoured out under the pier to a depth of 18 feet. Again, the use of sheet piling driven as an encasement and concrete underpinning of the structure was the solution.

Stream beds and creeks have a tendency to change their path of flow now and then. Unfortunately when this occurs the structure may no longer be properly situated to handle even the normal flow of water, let alone the 100-year flood waters for which our engineers guarantee they designed the opening. Proper channel alignment, therefore, is an important consideration in the prevention of scour, as well as an area where remedial action may be required. Unfortunately, not all bridges with scour and channel alignment problems are easily accessible with a backhoe or a dozer or perhaps even a D9 cat. When this is not the case, and in order to realign the channel, you either have to move the mountain by hand or figure out a way to get heavy equipment into the area to do the work. Either way you attack this dilemma, the cost of the work will normally not be cheap...which means that it normally is left unattended to...which normally means that the scour problem worsens...which may lead to a failure...which normally leads to your dismissal from the company...the proverbial vicious spiral.

Water flow in vastly misaligned channels can be somewhat brought back into line with the placement of jetties upstream. These jetties, usually made up of large size riprap or stone in a dam-type fashion, protrude into the stream or channel and influence the current to flow where it is most desirable, thus providing protection to the substructure.

Emergency Repairs

Regardless of how much preparation and planning is done to prevent the onset of scour, emergency situations are going to arise. It is during these emergency repairs that the ingenuity of the individual is put to a test. There aren't very many instances where one washout is going to resemble another. It seems that each one has its little idiosyncrasies that makes it stand out from the others.

Not much has been said about scour around non-bridge drainage devices like culverts and boxes, but they too are victimized by scour. It is usually in emergency situations, once the track has washed away, that any repairs to correct scour problems are performed. As an example, the sidewalls and half of the endwall were broken off a culvert due to an undermined foundation. Here it was thought that if the culvert wouldn't work, and since it wasn't totally gone, "let's just build a little jump span across, and wait for the whole thing to fall in."

The end of a reinforced concrete arch was undermined and fell off making the passage of trains rather difficult. Since repairing the arch was too lengthy a process, and filling in the hole with riprap was non-productive, the track was realigned off the broken end, so that trains could resume operation, and repairs to the pipe made. With the debris cleaned out and a new sub-floor placed, troughs were installed to allow for the transport of water through the culvert. Timber piling was driven to support the foundation of the culvert extension, the water was diverted, bin wall retaining walls were erected, and subsequently filled in with a sub-slab. Once the structural slab was poured, a structural plate pipe extension was constructed, and the bin wall headwall placed and backfilled.

Raging waters eroded roadbed shoulders. If it had been left alone it would have eventually scoured out the backwall and perhaps dropped the thru plate girder span into the drink. Once the waters subsided, timber piling was driven at the ends, and a timber retaining wall erected. With the receeded water, however, it became apparent that the pier foundation was also undermined. Again, in order to clear the structure for train traffic, riprap was placed surrounding the pier until a permanent repair could be made.

In some instances, however, no matter how much you try to repair and keep a structure from

totally collapsing, you might as well call it a day, let the waters recede a little, and come back prepared to build a new bridge.

Design Considerations to Scour Problems

In many streams, the depth of the river increases during floods at a greater rate than that at which the crest of the river rises. Since many bridges are located where the channel is narrow, the depth of scour is likely to be greater than the average. The addition of piers and abutments usually aggravates the constriction of the channel, and itself increases the potential depth of scour.

No universal rule is given for estimating the maximum depth of scour in a stream with a bottom of sand or silt. Experience with a given stream or river is probably the best guide in estimating the depth of scour, but as I mentioned earlier in this presentation, there are a few guidelines as to what type of scour line can be anticipated, depending upon the type of foundation system used.

Note that with a shaft foundation the river current near the base of the shaft has a tendency to whirlpool around the shaft as it tries to go past it. An identical shaft foundation, with perhaps an encasement at or near the base, provides the potential for scour reduction. If this encasement were to be vertically extended, however, the possibility exists for a greater depth of scour to occur than in the original shaft foundation. A simple underwater layer of riprap, or a collar, around the shaft at not too great a depth works almost identically to the first shaft encasement shown.

Anticipated scour depth for piers on piling foundation systems can also vary with depth of piers below water line as well as piling length. An awkward looking pier with its bottom near the normal water level has a more effectively reduced anticipated scour line than the piers with massive sections below the water line. Piers on drilled shaft foundations have been found to have similar results, with respect to anticipated scour lines, as those piers on piling.

Conclusion

I think that a majority of individuals and railroad companies take for granted the extent of damage that can be caused by the scouring away of materials. Most of us usually just end up dumping riprap around a hole, or watch to see how deep the hole will get, before we get around to dumping some riprap. Unfortunately, this approach, although perhaps successful the majority of the time, will eventually sneak up from behind and grab hold of you, throwing a serious problem into your hands, one that might have been inexpensively eliminated in the past when conditions were not as severe. I cannot stress enough the importance of familiarity with the conditions of the site, the stream, the substructure, and the history of the whole thing. Adequate record keeping of sounding measurement is essential, especially for the critical structures that cost a fortune to replace. Granted, the washouts are still going to happen. But with the ability to rectify small erosion and scour problems, and with a whole lot of luck, maybe you will only have to put in two days of working around the clock to put things back into service instead of a week.

I hope you've enjoyed this presentation, and I thank you for your attention. (Applause)

President Tallent: Thank you, gentlemen. You've put together in informative report. Randy Karsten will now introduce our next special subject.

Mr. Karsten: Thank you, Ray. It is now my pleasure to introduce Special Subject No. 2, which is entitled "Mechanized Bridge Gangs and Related Cost for Bridge Deck Renewals". Mr. John D. Allen and Mr. Charles M. Russell are committee co-chairmen of this report. John Allen graduated from North Carolina State University in 1952, with a Bachelor of Science degree in Civil Engineering, and in 1952 John began his railroad career as a junior engineer of bridges for the Southern Railway. He later went on to the position of bridge engineer. From 1965 to 1982 he was a partner with the Ford and Allen Construction Company and in 1981, John returned to the Southern Railway as engineer of grade separation and structures. Currently, he is engineer of structures of the southwest region with the Norfolk Southern. John is a member of the American Railway Bridge and Building Association and the AREA. He is a registered professional engineer in the states of Tennessee and Georgia.

Mr. Russell, who will present this committee report, graduated from Memphis State Univeristy in 1970 with a Bachelor of Science degree in Industrial Engineering. He began his

railroad career with Southern Railway in 1970 as a management trainee. Charles then went on to work as a track supervisor and then as a bridge and building supversior. Charles was a B&B supervisor for four years and a general bridge supervisor for 11 years in North Carolina. Presently he is assistant division engineer bridges at Decatur, Illinois, for the Norfolk Southern. With that, Charles, I'll turn it over to you.

SPECIAL SUBJECT NO. 2

Mechanized Bridge Gangs and Related Cost for Bridge Deck Renewals

Co-chairmen: J. P. Allen, Engr.Strs., NS, Atlanta GA
C. M. Russell, Asst.Div.Engr.-Strs., NS, Decatur IL

Committee: C. E. Thompson, B&B Mstr., CP, Burnaby BC
H. L. Davidson, Engr.B&B, CSX Trans., Corbin KY
S. Lipkus, Str.Engr., Deluc Consltg., Montreal QUE
H. C. Swanson, Asst.Engr., NS, Atlanta GA
R. C. Karsten, B&B & Utly. Supv., SLSW, Kansas City KS
T. C. Johnson, Pres., T.C.Johnson Co., Chagrin Falls OH

Total Cost

A major Class I railroad installed 30,000 bridge ties in 1988. This slide shows the raw material cost, the raw labor cost, and the overheads and additives applicable to these raw costs. You will note the material cost is $3,002,000 for an average cost of $100 per tie. Labor cost is $1,830,000 for an average cost of $61 per tie, and the overheads and additives are $2,676,000 for an average cost of $89 per tie. Labor overheads and additives are generally clear cut and well defined. Others, however, are not.

The figures shown here represent this particular railroad's attempt to define the cost for such items as investment in equipment, equipment maintenance including labor and material, operations of roadway equipment shops, purchasing, transportation, supervision, and other costs associated with the every day operations of the railroad. The cold hard fact is that the daily cost to run the railroad must be apportioned to the various operations being performed to obtain a true cost figure. The total cost for all items is $7,508,000 for an average cost of $250 per tie.

Another major Class I railroad that installed 25,000 ties in 1988 has advised that their average cost was $246 per tie, thus confirming the figures on this slide. These 30,000 ties spaced at 16 inch centers equates to 7.56 miles, which indicates that renewing bridge decks at today's prices cost $1 million per mile.

Gentlemen, I think each and everyone of you will agree that this is a very costly item, and I truly believe that with some imaginative thinking, hard work, and cooperation from equipment manufacturers, this cost can be reduced, and I will address this issue in a few minutes.

Installation: First Step

The first step in the installation of a bridge deck is the production of a plan showing tie location on the span and individual tie details. The plan should be accurate, and the marking sequence indicating tie location should be as simple as possible. Some prefer to number ties consecutively; however, this system fails to take advantage of the repetitive patterns that normally occur in bridge decks, consequently, creating more handling in the field.

The marking system should be consistent with the field conditions and reduce the handling of ties to an absolute minimum. It is very helpful if the ties can be bundled and numbered with designated ties in each bundle. An auxiliary

location plan can be shown to indicate the extent of the deck contained in the numbered bundle.

This slide shows a plan for track No. 1 of a double track deck truss span over the Kentucky River located between Cincinnati and Chattanooga. The type of tie is designated by a letter and runs from A through X. The ties are numbered consecutively within a panel with ties 100 through 120 being located in panel one, and ties 200 through 220 in panel two, and so on. This nomenclature is continued to the center line of the span located between panels six and seven and is then reversed with 600 series ties in panel seven, 500 series ties in panel eight and so on, until panel 12 which contains 100 series ties. The extent of ties contained in numbered bundles is also indicated with one-half or one-third bundles indicated at various locations. Individual tie spacing within the panels is also shown.

The next slide shows the tie bundling requirements indicating the type, tie number, and number of ties to be in a specific bundle. The cost to have these ties sorted and bundled with three 1-¼ inch bands with two chips per band was about $2 per tie, and was money well spent at this location. The five inch by eight inch timber guards were also bundled in 16, 20 or 24 piece bundles. Shipping directions required dunnage under all bundles to facilitate unloading.

This same criteria should be applied if the deck is to be installed as panels. Close coordination between the deck detailer and the field is required to insure proper panel length consistent with the equipment available to handle the panels and with track time available to install them. Prefabricated deck panels are now available from some suppliers, and consideration of this source should be investigated if the site warrants it.

Installation: Second Step

As shown by this slide, the second step in the installation of a bridge deck is the method to be used to install it. Since the method of installation is inherently tied to the machinery available, this is probably the paramount factor to be considered. There are two other important factors that impact the method of installation, and these are jointed rail and welded rail. Site conditions must also be considered, especially the storage area for the new deck and temporary storage area for the old deck. If deck panels are to be field fabricated, a construction site is needed and a bed or jig will be required upon which to construct the panels. Travel time from these areas to the work site has a bearing on the amount of available working time you will have. The bridge itself presents conditions that must be considered in determining the method of installation such as single track or double track, tangent or curve, inner metal guard rail, movable bridges over navigable waterways, walkways or floors, bridges over roads and highways, through girder and through truss spans, and bridges where tie depth is increased and a runoff is required. One other site condition that should be considered but is often overlooked, is the possibility of working from the ground or water adjacent to the structure.

This slide shows a barge-mounted tie handler replacing concrete ties on Norfolk Southern's Lake Pontchartrain trestle. This trestle is about six miles long, and in the early 1960s approximately 10,000 concrete ties were installed prior to laying welded rail.

The next slide shows the tie bundling requirements indicating the type, tie number, and number of ties in a specific bundle. In 1984, we began to replace the concrete ties with timber ties by working on track with the tie handler and four men including the machine operator. This operation resulted in the installation of 20 to 25 ties per day.

With the acquisition of work barges with spuds and a tug boat, the tie handler was moved to a section of track constructed on the barge, as shown by this slide, and tie installation went up to an average of 80 ties per day and approached 100 on several days depending upon the number of trains. The savings of this operation are the time required to clear a train. When working on track at mid lake, you travel three miles to clear and three miles back to the work site which requires a minimum of one hour. From the barge, you work up to the time the foreman has to clear the train and immediately upon its passage, work can again proceed. Virtually all routine trestle maintenance at this location is now performed from barges. If you have a site that lends itself to water borne operations but you do not own such equipment, investigation for renting the equipment should be made since the savings may well justify the rental cost.

Ties Under Jointed and CWR Track

There are actually only two basic methods of installing bridge ties and these are the installation of prefabricated deck panels or the removal and insertion of individual ties. Deck panels are much more adaptable to jointed rail. Fortunately for all of us, more and more bridges are being laid with welded rail. I'm not saying that panels cannot be installed under welded rail; however, it is more cumbersome, requires more time, and is more hazardous than with jointed rail.

These next slides will show the installation of deck panels under jointed rail on the St. Louis Southwestern Railway Company's bridge over the Kaw River at Topeka, Kansas. The panels were constructed adjacent to the track at the end of the bridge. Panel lengths were 25 feet 6 inches and relay 136 pound rail was temporarily attached to the panels. The jointed rail on the bridge was cut to permit the removal and installation of the panels. This slide shows the 60 ton Holmes hi-rail truck crane with a 26 foot boom used to handle the panels.

This slide shows a new panel being installed. A total of 450 feet of deck was installed in three days with approximately a six hour break in traffic each day. New 136 pound welded rail was later installed on the bridge and approaches. The work force consisted of a bridge foreman, four bridge men, and four track men. The crane was rented at a rate of $120 per hour, including an operator and oiler.

Panel Installations Under Welded Rail

The next slides show the installation of panels under welded rail on Norfolk Southern's bridge A-1.7 at Alton, Illinois. The panels were constructed in lengths of 15 feet as shown on this slide and were fabricated adjacent to the track as seen in the right side of this view. One timber guard was secured in place and four inch by four inch steel angles were installed along the full length of the panels on both sides at the lower corners of the ties, and spiked in place with 50d nails through torch cut holes in the up-standing leg of the angle. One of these angles can be seen on the panels in the foreground. The old deck, as shown by this slide, was paneled in the same lengths with similar angles attached to the lower corners of the ties and one guard timber was taken off to allow removal from beneath the rails. Spreader chains were connected between these angles at each end of the panels and both crane lines with slings were hooked to the spreader chains to handle and tilt the panel for removal and insertion under the rails.

This slide shows the panel suspended over the side ready to be slid in beneath the rail. This slide shows the panel in a tilted position just starting under the rail, and this slide shows the rehooking of the slings to clear the first rail and continue the insertion of the panel. The next slide shows the second rehooking of the slings to clear the second rail and complete the installation. This deck consisted of 265 ties and was installed under extremely short working periods at various times throughout the day. The work force consisted of a foreman, five men and one supervisor.

Individual Tie Renewal

This slide shows a deck installation by individual tie removal and insertion on a CSX bridge and involves the use of safety nets for fall protection. The primary equipment is a tie handler and push cars that are used to remove and replace the components. This slide shows a combination rail lifter, spike puller, and spike driving machine which is supplemented by the usual support tools consisting of a generator, drills, and impact wrenches.

Once the guards have been removed, the combination machine, as shown by this slide, lifts and blocks the rail about four inches above the ties. Normally, 12 to 16 ties are removed at one time. This slide shows the tie handler removing and loading old ties, and this slide shows the new ties being installed. With the new ties, pads and plates in place, the combination machine lifts the rails to remove the blocks and lowers the rail into place on the plate. Spikes are set by hand and driven with the combination machine. This operation takes about one hour and 45 minutes to complete and be ready to pass a train. The work force consisted of a foreman, four men and one machine operator.

This slide shows a deck being installed on Norfolk Southern's Wabash River bridge at Attica, Indiana, by individual removal and insertion using rail restraint fall protection. Two primary pieces of equipment are involved, one is a tie handler, and the other is a hi-rail crane. The crane was used to shuttle old ties off the

bridge and new ties on with the tie handler performing the removal and insertion. This slide shows the new ties placed on the rails by the crane and the tie handler installing them.

This slide shows an air compressor on a push car that provides air for spike driving, drilling, and impact wrench operation. The next slide shows a scaffold seat mounted to a rail restraint for installing hold-down bolts and can be rolled from one position to another as installation proceeds. This slide shows a theodolite set up on an offset track center line and after the hold-down ties are bolted, one rail is lined and spiked to each hold-down tie using an offset target that fits over the head of the rail. This offset line permits the rail to be lined and spiked while men and equipment are on the bridge. This slide shows the use of the rail restraint fall protection device that travels along the rail during movement of the restrained worker. It has been aptly named puppy dog by the workers since it follows you around just like a puppy. Two similarly equipped gangs working from each end of the bridge, consisting of a foreman and eight men each, installed 947 ties in eight days. Uninterrupted work time averaged six hours per day, and in one day with a ten hour work time, 344 ties were installed.

Equipment Types Available

The four decking operations that we have just reviewed involved a tie handling machine and a hi-rail crane as the primary equipment.

Let's now look at some of these machines that are currently available. But first, how many people in this room remember the machine shown in this slide? When Fairmont introduced this hand-operated derrick, it was the answer to many bridge maintenance problems. They probably did not realize the versatility of this derrick and never envisioned the installation of a gasoline driven hydraulic hoist and travel system, but I can assure you that many railroads so equipped them, confirming the old adage that necessity is the mother of invention. This slide shows the result of evolution in the Fairmont product.

The next slide shows a similar machine from Tamper Corporation with another evolutionary feature of the center jack turntable and crawler tracks to clear the worksite. A railroad track is a unique structure and is designed especially for movement of steel flanged wheels, and anyone who has ever struggled trying to get conventional rubber mounted or crawler mounted equipment down a track to a bridge site can readily attest to that fact. This problem led to the development of hi-rail flange wheel units capable of being applied to conventional equipment.

This is a slide of a Galion hydraulic crane capable of traveling on the tie heads and which can be equipped with hi-rail gear if desired. This slide shows a Grove hydraulic crane with hi-rail equipment. This slide shows a Bantam hydraulic crane with hi-rail gear, drawheads and assorted accessories. There are many such units on the market and they can be produced to meet individual railroad specifications for certain desired components and accessories.

An All-Task System Concept

In the introduction, I mentioned that some imaginative thinking, hard work, and cooperation of equipment manufacturers could reduce the cost of bridge tie installation. This slide shows what we have entitled an automated bridge decking concept and indicates various machines, their direction of travel, their relative positions, their general function, and the task that each needs to perform.

Basically, this concept consists of a guard remover, tie remover, tie installer with an alternative of dividing this machine into two units instead of one, and finally, a guard installer. I realize there are many problems involved with this concept and that development costs may seem prohibitive. Based on one railroad's 1988 program of $7,500,000, there is probably close to $100,000,000 spent annually by the major railroads in the United States replacing bridge ties.

One only has to look at the variety of automated track maintenance equipment on the market today and ask why not similar bridge maintenance equipment. In the June, 1989, issue of Railway Track and Structures, Merwin Dick rationalized the lack of mechanized bridge equipment by noting the non-uniformity of bridge types compared to the consistent uniformity of the track structure and, undoubtedly, this is a major factor. Granted, we have a multitude of hoists, cranes, tie handlers and other assorted pieces of equipment that are very adaptable to B&B work; however, none of these have the capabilities to perform all the

tasks shown by this concept. It is probably impractical to develop this concept for producing the equipment for sale to the industry. However, with the current emphasis to reduce cost and employees, it seems very practical for someone to develop a concept to provide a bridge decking service to the industry similar to ballast cleaning, rail grinding, rail testing, and in-place treatment of timber trestles. Such a service should be all inclusive, consisting of plan preparation, material procurement, material installation, and the disposition of the old material.

This is the slide that opened this presentation, and I show it again to emphasize that overheads and additives amount to an average unit cost of $89 per tie which is 36 percent of the total average unit cost. The preponderance of this cost is associated with equipment and people and the quickest and most positive way to reduce this cost is to purchase the service. Long standing traditional railroad concepts and procedures are rapidly changing, and we in B&B must recognize this and react accordingly, or we will find ourselves standing in the wings.

Thank you very much. (Applause)

President Tallent: I think Charles opened a lot of our eyes on the actual cost of installation. Some people don't realize what the total cost is when you go to install a bridge deck. A very good presentation. Thank you Charles.

I want to remind everyone that before you leave today pick up a blue card in the back. 1990 is right around the corner, and the blue card lists the special subjects for the 1990 conference. We'd like to have your input so take time to fill one out, and send it in, because planning for the 1990 conference starts at the December Board meeting.

At this time John Horney will present the next feature. John.

Mr. Horney: Thank you, Ray. Our next presentation is a special feature on the renovation of the Washington Union Station and will be presented by David Ball, senior contract administrator for the Union Station Redevelopment Corporation, which was charged by Congress to redevelop, through renovation and restoration, the historic Union Station at Washington, D. C., into a multi-use transportation terminal and commerical complex. He has been with the Corporation since its inception in 1984. Prior to joining USRC, Mr. Ball was employed by Parametric, Incorporated, as a program manager for the Northeast Corridor Improvements Program. He was involved in inspection, estimating and manpower loading for the construction of railroad facilities. He holds a Masters Degree in Urban Planning from Howard University in Washington, D. C. where he has also taught graduate level planning courses. Please welcome David Ball.

RENOVATION OF WASHINGTON UNION STATION

D. S. Ball

Senior Contractor Administrator
Union Station Redevelopment Corporation

Good morning, members and guests of the American Railway Bridge and Building Association. I'm happy to be here with you today to share my experiences with the redeveloping of Union Station.

My presentation will briefly cover the history of Union Station, what the Redevelopment Corporation is about, the status of the station today and a brief slide show.

The McMillian Commission Plan of 1901 set the stage for Union Station. Daniel Burnham was selected as the architect of the station in 1903 and then started the construction of the station. Construction was done by the Washington Terminal Company. The station opened in 1907 and was technically completed in 1908. The statues which grace the exterior of the building along with Columbus Plaza were completed between 1912 and 1913. Up until 1917 the station was managed by the two railroad terminal companies that owned the building. Between 1917 and 1919 the War Department took over the station for use in World War I. World War II was the busiest time for the station. Between December 7, 1941, and the end of 1945 an average of 175,000 people a day passed through the station. After 1945 the decline of rail passenger service started with the advent of the airplane. In the late 1950s and early 1960s the status of the station was questioned by the two railroad companies that owned the station. As a result of a presidential commission and different congressional studies the National Visitors' Center Act was passed in 1968. The Act provided for a place for tourists plus a 2,000 to 4,000 space parking garage. It provided for the replacement of existing railroad facilities by moving the train station inside this historic building to a location behind the parking garage. Work for this started in the late 1960s and the replacement station opened in the early 1970s along with the National Visitors Center. The garage work stopped in 1976 due to cost overruns.

In 1978, the National Park Service drastically curtailed its services to the National Visitors Center due to the failure of the general public's use of the building. At this point train service was still located to the rear of the station and passengers had to walk through the historic building back to the concourse to actually purchase a ticket.

Congress appropriated money between 1980 and 1981 for the restoration and repair for the roofs of Union Station. In December, 1981, there was a heavy rain which caused severe roof damage and a lot of plaster was lost inside the building. As a result of this, the station was closed to the general public and there was a temporary passageway which was constructed inside the concourse to route the people to the rear of the station to board trains. As a result of this situation, the Union Station Redevelopment Act of 1981 was passed. This Act provided for four major items:

- It provided for the preservation of the exterior facade and other historically significant features of the building.
- It provided for the restoration and operation of a portion of the historic Union Station as a rail passenger station with holding facilities for chartered and public buses.
- It identified commercial development that would financially support the continued operation and maintenance of the building.
- It provided for the withdrawal of federal support at the least cost to the U. S. Government.

The Act also provided that the building leasing rights transfer over from the Department of Interior to the Department of Transportation. It identified the need for a study of the exisiting conditions to the building as well as a study of

the economic development potential of the building. It provided for the completion of the parking garage with $40 million Department of Transportation Federal Highway Administration money that would be administered by the District of Columbia government and provided additional cause for the National Parks Service to complete the roof repairs. An Existing Condition Study basically went through the building and identified the historically significant areas of the building and the report said that the building was in good structure but needed some emergency repairs which consisted of structural and electrical repairs. The development report identified 100,000 square feet of potential retail space in the building and said that the station could economically support itself. As a result of these two studies, the Union Station Redevelopment Corporation was incorporated April 14, 1983, in the District of Columbia as a non-profit organization. It's mission was to carry out this Act by Congress.

Union Station Redevelopment Corporation, or as we call it, USRC, consists of a staff of four people: a president, a vice president, an executive secretary, and a contract administrator. At that point, our mission was to create a development team that consisted of a developer, the architect-engineer and the construction manager. Seven potential development groups had been identified for the Union Station project. Three of those groups received RFPs, Requests for Proposals. Two of those groups responded. It is interesting to note that both developers that responded identified the need for 200,000 square feet of retail space to make the building economically viable instead of the 100,000 that the Existing Condition Study recommended. At the summary review, an award was made to the preferred developer, which is Union Station Ventures, and consists of LaSalle Partners, who are financiers, Williams Jackson Ewing, the retail leasing people, and Benjamin Thompson Associates as the architect for the developer. This award occurred in June, 1984. At that time the Corporation posted notifications in major newspapers and periodicals seeking to prequalify interested architectural and engineering firms for the renovation and restoration of Union Station. We had over 40 responses to our requests for qualificiations. Ten of those firms were short-listed and received RFPs, Requests for Proposals. It was a selection committee who decided on who would be short-listed and the selection committee was comprised of appointees from USRC's Board.

In July, 1984, we awarded the contract for architectural engineering services to Harry Wease and Associates. The following month, we again posted notification to major newspapers and periodicals that we were seeking to prequalify construction management firms for the bidding of Union Station. We had 37 responses, 12 firms were short-listed by the selection committee. An award was made in the fall of that year. Going into 1985, we had our complete team in place.

Beginning in 1985, our goals were twofold. One was to reach a development agreement with USV, the preferred developer, and the other was to go to construction to achieve an opening by 1988. Our developer negotiations centered around the following items: what improvements the corporations would do at our cost to improve Union Station; what improvements would be the developer's responsibility at his cost; the treatment of historic spaces in the building; the leasing plans that the developer was proposing and most important, was the rent agreement which would exist between the Corporation and the developer. We needed to decide these items very quickly because of the different approval processes that the restoration would require. We required approval from the National Capital Planning Commission, the Commission of Fine Arts, the Advisory Council on Historic Preservation, and USRC's Board of Directors. Our Board consists of the Secretary of Transportation, who is the chairperson; the Administrator of the Federal Railroad Administration, the president of Amtrak, the president of Federal City Council, which is a business organization in the city, and the mayor of the District of Columbia.

The outcome of the negotiation with the developer had a direct impact on how our architect designed the building, based on what amenities the developer would require to place into the building. In the same time period we were interested in going into construction. The short-term repairs contract which was for the electrical and structural items in the building had been completed in the summer of 1984. At that point, our architect/engineer was going through the building, investigating different

items in the building, doing a historic paint analysis and vibrational studies. It was decided that in order to get a jump on the restoration process to achieve an opening by 1988, that we would split a demolition package out of the restoration/renovation contract. The demolition package, as we identified it, would consist of several items that the developer had asked for. We had originally looked for 100,000 square feet of retail space in the building. The developers came back and said they needed 200,000 square feet of space, so we ended up using what we considered the basement and inserting a couple mezzanines throughout the building.

The demolition contract consisted of lowering the basement floor and removing close to three feet of floor fill throughout the building, removal of non-bearing walls, and removal of all improvements placed there by the National Parks Service. We were able to send out a bid package on the demolition of the station in September, 1985. This package went out right after we sent out our asbestos abatement package in August, 1985, which required an architect/engineering firm to do an analysis of the asbestos conditions in the building, go out to bid within the 60 day period, and have the building completely asbestos free by the time the demolition package was to be bidded.

Award was made on the demolition package in October, 1985, with notice to proceed that following December. This was a 180-day contract which was completed a little bit early because the contractor finished in May, 1986. At that point our architect had been working with the developer and the restoration packages were completed to go out for bid. We released our bidding packages in June, 1986, and went through the bidding process with the award being given to Dick Corporation from Pittsburgh in September, 1986.

The restoration package consisted of window repair and replacement, ornamental and flat plaster work, ornamental metal restoration, marble work, granite repair and cleaning the Amtrak Station. We inserted new mechanical and electrical systems throughout the building.

In January, 1988, we also let a graphics package which consisted of static signs as well as electronic signs.

This is the station as it looked in 1984 when it became a ward. This plan shows the relationship of the station to the U. S. Capitol, the Supreme Court and the Library of Congress. It also shows the major transportation arteries which feed into the station as well as the tracks which enter into the station.

Columbus Plaza was erected in 1912 and 1913. This shows the Capitol area around 1900, before the construction of Union Station. There were two stations located on Capitol Hill, both at the base of the Capitol. These are six statues which grace the exterior of the station. The two on the east represent fire and electricity, which are some of the major elements in terms of the operation of railroads. The two on this end represent mercantile and economics and the two on the inside are imagination.

This is the station about 1910. In the background you can see backlit signs, so we're moving up in the time scale. This is the station in the early 1920s. This entire glass window had to be replaced and all the ornamental ironwork also had to be redone. This is the station in the late 1960s. These are pictures of President Taft using the station, President Roosevelt and the Queen of England and the King of England. This is the station during 1943. As you can see, with the amount of people using the station, a new ticketing information station had to be placed inside the hall. This is our baseball team, when we used to have the Washington Senators, returning from an 18-1 road trip. Here is President Kennedy and his wife greeting dignitaries. This is the station in January, 1953, a couple of days before the inauguration of President Eisenhower.

This is the station under construction when the National Visitors Center was built. This is the main hall and this is the basement area of the station. This is the National Visitors Center. What you are looking at is the PAVE, Primary-Audio-Experience area. You can see where we had to cut in for the new grade beams and footings which will carry new columns to support the closing and opening of the floor. This area also houses the nine theater complexes which are located in the lower level. If you can take a close look up here you can see the scaffold work. This scaffold was placed on wheels and they made five passes coming down the main hall to do restoration of the plaster ceiling.

This is the merchandizing plan on how the station is used today. The red identifies sit-down

restaurant eating; the blue is retail and the yellow is cafe dining.

This is Union Station nearing its completion. The central island was inserted by the developer to give us additional retail space and to get a flow of people to move in and out of the main hall.

This is an architect's rendering of what he thought the station would look like once we had completed the restoration. It's interesting to note that this central element, the clock, was deleted by the historic society which does not want someone coming to the station and not being able to tell what was old and what was new.

This is the station as it existed on opening day in September, 1988.

Part of our restoration work centered on new light fixtures inside the building. When you go through the station, these light fixtures sit on these corner columns and give a warm glow to the ceiling. The gold that you see is gold leafing throughout the building. This is the train board that was replaced in lieu of the time clock that was originally requested. You'll notice that all the trains are operating on time. (Laughter) This area is the old baggage area where, in 1907, the baggage was handled on this side of the west hall and tickets were purchased on this side. You can take a look at the type of damage that occurred in the ceiling to the plaster. We opened up all the skylights in the building. There are about 27 different roof structures and we installed close to 47 different skylights.

The marble flooring in the building which goes through the main hall and all throughout is all new work. This is a picture of the east hall which houses the Saverin Restaurant, which is one of Washington's finest restaurants. The chandeliers that you see in here and also the wall sconces around were no longer in existence when we came on board. All those fixtures had to be refabricated. This is the same room, the east hall, that housed the National Visitors Center bookstore. This is about how we received it in 1984.

As part of the architect's investigation of the building we were able to identify some existing historic stencilling and canvasses where we were able to achieve the original colors of the building. This is work on some of the tapestry. All of this work that you see was hand painted, hand stencilled on the board with a piece of tapestry inserted in the middle. Again, we're in the east hall after restoration.

These columns are what you call a scabriola finish which is a marbleization of plaster work. These wall sconces had to be refabricated from gold. If you notice, the colors here over on the east wall are very loud. As we move to the lunchroom which is adjacent to the east wall you'll see a change in tones. The east hall is basically a merchandising area that has different types of small odds and ends that the traveler may need.

This is the lunchroom which existed next to the Saverin restaurant. Right behind these window panels is the concourse where one used to board the trains. As part of our restoration in terms of identifying more retail spaces in the station we inserted a new mezzanine level right about this corner. You'll see it in the next slide. This is the same room. This is the new mezzanine deck and the new plaster work.

Our historics required us, in terms of items that were not historic in nature, to change the design so that the person would not be confused between what was 1907 and what is new. This is the Presidential Room as we received it in 1984, the only area in the building which had the original marble flooring along with the original chandeliers and wall sconces. This is the same room once we finished it. It's completely restored. The only items that are in here that were not in here in 1907 are the sprinkler systems which were required by the insurance department. This is the same room as furnished by the restaurantur Adriondacks. It is interesting to note that in 1907 the doors had glass panels. Sometime during the 1920s these glass panels were replaced with solid mahogany panels for privacy for the president. This is the bar to the Adriondacks Club between the east hall and the presidential suite and used to house the cooking area for the old restaurant.

This is the concourse. It used to be the boarding area for train passengers. This area right back here is a temporary passageway that was used for Amtrak travelers once the station had been closed. They used the walkway to get back to the replacement station at the rear of the building. This is the concourse as it was maintained by the National Parks Service. You can see the type of water damage that was occurring prior to our reconstruction of the building and prior to the National Parks Service completing the roof work. As part of our

restoration and renovation we provided these concourse cutouts which cut the concourse ceiling into the main hall and allowed the visual experience from this side of the building to look into the main hall. You can see scaffold work is going on for the restoration and replacement of plaster ceiling as well as scaffold work which is building the mezzanine level throughout here. The concourse was 600 feet long. It was 720 feet in length but when National Park Services took over the building they cut off 60 feet on each end of the building to allow for ramps to go to the parking garage. So we have a 600 foot span here and as part as the idea to get more retail space in the building, we inserted a mezzanine level in this area. What you see is the penetration that we made into the floor to allow a person up in the main level to look down into the lower level and see the different types of retail activities that are occurring and Amtrak's new ticket desk will be right back in the rear of the station.

This is the station getting closer and closer to grand opening. We took this picture in July, 1989. You can see the concourse cutoff has been completed, new plaster work has been installed, scaffolding has now moved down to the extreme east of the building and Amtrak's ticket counter has been completed.

This is the station as it appeared right before grand opening. The Limited is the major anchor store at Union Station at the east end of the station. The Limited is an upscale women's retail store and the station probably has a predominance of retail stores for women.

This is a shot of the lower level and shows the nine cinema complex in the basement. The orange is fast food areas, red is restaurant and yellow is cafe dining, while the blue consists of retail. We also have direct access to Metro on the lower level. These are metro tracks which run on the west side of Union Station. These tracks right here carry Amtrak's passengers south. They actually go underneath the building and Amtrak's operation area for baggage handling is located in the rear of the basement in the lower level.

In terms of our improvements, the Corporation was responsible for all items that would occur in public areas while the developer was responsible for that which would occur behind the tennant lease line.

This is the station as it occurs today. These signs are part of our graphics contract and consist of part of the static signs that were required.

Part of our contract as we worked with the restoration is that we inserted baggage carousels. We have two inbound carousels and one outbound carousel where a passenger can come and drop his bags off at the ticket counter when purchasing a ticket. The baggage is dropped downstairs on the carousel and placed aboard a train and the same thing occurs when a passenger comes into the station where the baggage will come up via the carousel and the passenger will go there to get his baggage.

This is one of the historic train gates as part of the metal restoration that was restored. You can look in the back and see our electronic signs as well as television monitors as part of the graphics and signage package. This is the replacement station as it existed prior to our construction which was constructed as part of the National Visitors Center. This is the parking garage which existed behind the building and houses approximately 2,000 cars. It was built by the District of Columbia government and was turned over to our Corporation to manage. Thank you. (Applause)

President Tallent: Thank you, Mr. Ball. At this time I would like Tom Dunn come forward and introduce the next special subject.

Mr. Dunn: It's my pleasure to introduce Bob Carter and Don McCammon, who are co-chairmen of Special Subject No. 3, "Critical Problem Areas of Timber Bridges". Bob Carter is general B&B supevisor for the Burlington Northern at Springfield, Missouri. He has over 27 years of experience with the railroad, about 22 of that in the engineering area, several as a B&B supervisor. Bob is married and has seven children, and I think he deserves a special thanks for helping prepare the report, fitting it in between the demands of job and family. I'd also like to congratulate Bob on his nomination to be a director of this organization.

Before starting his railroad career, Don McCammon spent six and a half years doing bridge construction and surveying for the Montana Department of Highways. He obtained a degree in Civil Engineering from Montana State and went to work for the Burlington Northern as a trainee in 1982. He has since held positions of assistant roadmaster, assistant B&B supervisor, assistant structural engineer, and manager of engineering information systems,

general supervisor, and is now manager of bridges and buildings on the Burlington Northern's Denver division. Don is a licensed professional engineer in Kansas, Montana, and Colorado, a member of the American Society of Civil Engineers, the B&B Association, and chairman of an AREA sub-committee to upgrade and extend the life of timber bridges. Gentlemen.

SPECIAL SUBJECT NO. 3

Critical Problem Areas of Timber Bridges

Co-chairmen: R. W. Carter, Gen.B&B Supv., BN, Springfield MO
D. L. McCammon, Mgr.B&B, BN, Englewood CO

Committee: W. H. Nelson, Mgr.M/W Trng., BN, Overland Park KS
M. L. Bradley, Proj.Engr., Conrail, Dublin OH
R. W. Emmrich, Mgr.of Engrg., Osmose, Madison WI
R. F. McGuire, Area Mgr., Osmose, Lenexa KS

Special Subject No. 3, Critical Problem Areas of Timber Bridges, is extremely important in today's world of economy, budget cuts, competition, high material costs, reduced maintenance crew size, non-existent construction crews, and attempts to increase the life span of our existing physical plant. The timber itself is becoming scarce. Today we look at six months to one year plus lead time to even obtain the large size timber we use. By recognizing the problems we are having with our structures and sharing our ideas on the solutions we can all be better managers of our structures and scarce resources. While this committee addressed the problems, others, in the past, have addressed the solutions, and we are sure that future B&B Association proceedings will assist us with more innovative solutions.

Extent of Timber Use

Timber bridges have been in use since man or woman first wanted to cross a stream without wetting their feet. They have been supplanted by masonry, stones, concrete, and steel, but they are still the mainstay of today's railroads. Two major class one railroads still have 36 to 40 percent of their total bridge length of 546 miles as timber. This does not include bridges where timber is used for approaches or where there is a timber substructure. Timber is used as falsework to support new construction and has been used as approaches to steel and concrete structures. We, as bridge and building supervisors, are being told to maintain our existing timber structures until the last possible moment before replacing them.

Timber Bridge Components

Since timber bridges have been in use different terms have grown up describing parts of the structure. Items like "hog jaws", "mud sills", "fenders", "tie spacers", "trestle", and "caps" are used. They mean different things for different railroads. They even mean different things within one company. So that we are on common ground, a trestle is a bridge consisting of relatively short spans supported by bents. Bents, or the support structure, may be composed of properly braced and supported timber piles and caps or concrete caps. Frame bents are composed of posts, usually 12 inches by 12 inches, caps, and sills braced and supported on piles, mud blocking or concrete footings. A bent may have from three to seven piles or posts.

The number of pile or posts depends on the length of span, height, or bent, the lading, and the ground support. When piles are used the structure is known as a "pile trestle" and in other cases, when posts are used and secured by transverse framing, the trestle is called a "frame trestle". The lateral stability is obtained by planks extending diagonally across the bent, sway bracing. Longitudinal bracing between

bents, if needed, is provided by "girts" and "sashes".

The maximum height of pile bents is often limited to 30 feet due to the availability of tall trees for piles. Higher trestles are generally framed on piles or "mud sills", timber foundations that spread the load to the soils underneath, or concrete cast in place foundations. The top transverse member or "cap" is generally solid or two pieces of timber bolted together or, if concrete, prestressed or cast in place. Tall trestles, constructed in stories, have intermediate caps.

Stringers run parallel to the track and span the opening between the bents. The quantity and size are dependent on the span and the loading with sizes running from 8 inches by 16 inches to 18 inches by 28 inches. The typical span runs from 13 to 15 feet. Stringers can be chorded, i.e., two or more stringers lying directly beneath each running rail bolted together or spaced, stringers spread under the entire deck with gaps between. They also may be continuous over multiple spans. The stringers support a deck. An open deck is one where the ties lay directly on the stringers. A ballast deck has a timber flooring system with a ballast retainer which supports ballast and the track structure.

Effects of Moisture

Most timber used in railroad bridges is plant treated with chemical compounds to decrease decay. Creosote is the main preservative in use in North America. The timber itself is a product of nature. It is a natural polymer composed of cellulose and lignin. There are about 30,000 different species of trees not to mention different growth cycles and climates, so it is not surprising that timber is a variable material. The design and use of lumber from timber is dependent on moisture content, temperature, and the mechanical properties.

Moisture affects the shrinking and swelling of timber. It also is a necessary component of decay. It affects stiffness, toughness, and fracture morphology. Generally the modulus of elasticity and strength increase with a decrease of moisture content below fiber saturation point. This is greater than the effect of temperature. It especially needs to be controlled when cutting the timber to insure the proper size will be achieved.

Effects of Temperatures

Temperature affects the size of wood, its moisture content at any given relative humidity, and its thermal conductivity. Timber maintains strength with increasing temperature and time of exposure. At low temperatures accompanied by high moisture content, the strength of wood generally increases with an increase in moisture. However, at extremely low temperatures with moisture present in the timber it has been known to shatter when suddenly impacted.

Strength and Elasticity

Wood has three mutually perpendicular axes of symmetry: longitudinal, or parallel to the grain, tangential, and radial. Due to the directional cell structure of wood the properties of strength and elasticity differ greatly in those three directions. In addition, such natural defects such as knots, knotholes, ring width, the ratio of heart wood to new growth, density, and cellular structure have a great bearing on the strength and weathering characteristics. Timber does not behave in a truly elastic mode but has a time dependent behavior. It can handle short heavy loading but will deform and fail with long term applied overloads.

AREA Chapter 7 contains standards, specifications, design guidelines, and recommended construction, maintenance, and inspection practices. There are occasions when these guidelines are not followed. As you will see in the following slides some of the problems concerning timber bridges could have been prevented if they had been followed.

Service Life Factors

The problems seem to fall into two categories: weathering and mechanical. Weathering causes splits, checks, shakes and promotes decay. A drastic form of weathering is fire. Marine borers are another form that eats wood fibers. Mechanical wear is caused by crushing, pounding, bending and is usually increased by the effects of weathering. Weathering and mechanical wear seem to occur in areas where the most stress is found or where a lot of fastenings or construction methods have destroyed the protective barrier of the wood cell structure and/or any preservative treatment.

Fires

Fire occurring on a timber bridge represents a major catastrophe. The timber, soaked in creosote, sitting in the hot sun creates a highly combustible fuel. Farmers burning ditches, trains creating sparks, rail grinding, track welders welding rail, track workers cutting rail, and grass and forest fires all represent dangers to timber bridges. This list does not even include our own crews who have been known to accidentally start fires on our bridges. These shots of this bridge were taken from the caboose of the last train to go over the structure. Several coatings have been developed to prevent fires on structures. Most work as a barrier to separate the source of combustion from the fuel. However, due to the properties of timber a structure can still hold loads even with some surface charring.

Decay

Splitting, checks, and shakes provide an opening for decay organisms to get into untreated wood or areas that have received less treatment. They also decrease the ability of the member to carry load. Ice cutting and debris hitting causes wear on piling. Loosening of bolts through repeated loading and shrinking and swelling of the timber caused by humidity changes also increase the mechanical wear through the inability of the connections to pass stress from one member to another.

A major problem in bridge deterioration is decay. Four factors must be present for decay or fungi to utilize wood cell material as food—free oxygen, favorable temperature, supply of wood cells, and moisture are needed to provide fungi a good growth environment. The life span of timber bridges is drastically reduced where these four conditions exist. In other areas, especially dry areas, timber bridges can last 70 to 100 years with minimal maintenance.

Given the above criteria for decay growth, one can see the problem areas on a timber structure. Any place water can collect or be trapped such as top of caps, piles and stringers and any place the preservative protection is broken such as splits, checks, bolt holes, drift pins, and spikes are prime candidates for the occurrence of decay. Another area where decay occurs is at the ground line. A constant high moisture, temperature and protected environment exists there that provides fungi a natural home. Fungi or decay in piling is usually not visible as a shell is left. It can easily be detected by sounding or boring. It can also be detected when the pile fails.

Corbels and caps can be visually inspected or drilled and sounded to determine decay presence. Ground line decay can only be detected by excavating. As seen here, the above ground portion of the structure looks good. However, the support which was unseen is basically nonexistent. Decay, if left too long, can also be easily detected as in this pile, where the process started at a bolt hole for sway bracing.

Timber deck ties are also subject to decay. They are usually the most exposed surface to the weathering elements while at the same time receive the most abuse from the train traffic and track crews repairing or replacing track components. The timber floors on ballast deck bridges are also susceptible to decay as the ballast generally retains moisture while at the same time hiding problems from top view.

Marine Borers

In marine environment locations, mother nature hands us another small creature that likes to eat wood, marine borers. The damage they cause occurs mainly in the tidal zone and can drastically reduce the pile cross section.

Wood Preservation

Our former favorite preservative, creosote, was recently declared a carcinogen and is now highly regulated as a pesticide by the EPA. This has basically caused most, if not all, railroads to stop using it as field treatment for fresh cuts and holes. Today, as in the past, the art of timber bridge building and maintenance involves using chain saws, chisels, drills, and other hand equipment on creosote treated timber. This resulted in the treatment being broken and untreated or slightly treated wood being exposed. This provides for increased decay and weathering. It also, in the case of fitting stringers, provides a stress point for structural cracking, as in these field sized stringers without any field treatment.

Mechanical Wear

Mechanical wear is becoming more prevalent in these days of unit heavy axle trains. In many cases, bridges that were built 60 or more years

ago were not designed to handle the loads we have today. The problems created by this have decreased the life span of our bridges. Not following good design practice has also created problems. Here we see several shots of a timber bridge on a skew. While this is an extreme example, you will note that there is not adequate bearing area for the stringers to transfer the deck loads onto the caps. You will also note that the force has caused the cap to crush and start to crack. In addition the force has caused the bents to be driven deeper. While the pile settlement is not a drastic case, it illustrates a problem in that usually drop hammers were used in the past to drive pile. In addition, pile driving was more of an art than a science. In many cases the piles were not driven to today's standards, and shims were added to alleviate the resultant dip in the deck. These shims were not hardwood, and they too have begun crushing.

Increased mechanical wear on stringers and piling is most noted in areas where traffic characteristics have changed. Sixty years ago the line handled passenger traffic with occasional freight trains. Today, the line handles the occasional freight and passenger train with many heavy axle unit trains. Where once three 9 inch by 16 inch stringers per chord were adequate, four and sometimes five 9 inch by 24 inch stringers are now necessary to carry the load.

Pile pumping and frost heaving or differential settlement bothers not only bridge grade but also alignment. Not only is pile movement a problem but mechanical wear is harder to determine other than outright crushing, as it looks very similar to splits, checks, and shakes. A maintenance solution to bent settlement has been adding additional caps or shims. It must be noted that this decreases the stability of the bent as you now have several members stacked on top of each other. The crew generally does not worry too much about longitudinal and lateral bracing.

Timber decks receive a high amount of mechanical wear. In some cases it can be prevented by use of tie plate bearing pads, a cushion between the loads and the timber. These areas are also one of the most exposed to weathering combining the two problems to create a high repair and maintenance area of the bridge.

Increasing dead load caused by added ballast or adding concrete ties, especially on ballast decks, decrease the live load carrying capacity. The deeper deck section requires better designed ballast retainers. A single bolt every third or fourth deck plank, especially with deeper retainers or stacked retainers will not resist the loads of train, track, and deep ballast. This is critical on curves in welded rail territory and the advent of concrete tie usage.

Mechanical wear caused by frequent rail relays on open decks and subsequent adzing on the ties reduces preservative protection, cuts into tie thickness, causes spike hole wear, and, in many cases, the rail gang tosses the tie pads instead of reusing or obtaining new ones.

Proper maintenance of the bridge approaches to reduce pounding on the bridge and hence mechanical wear by trains either approaching or leaving is a favorite bone of contention between track and bridge people. Roadmasters seem to procrastinate and B&B supervisors become more irritated over this one item than anything else involving multiple departments.

The back walls and/or wing walls retain the track subgrade and ballast. These are susceptible to rot and wear from rail if the track is not maintained properly. In one case, the wing wall was hit by the wings of a ballast regulator. This broke the timber. Washouts and other erosion occurs underneath the back wall causing loss of soil which is reflected all the way to the track structure.

Conclusion

We have had an opportunity to look at some of the problem areas of timber structures. I am sure each one of you has experienced many of these problems and some that we have not mentioned. Our shrinking resources of manpower, money, equipment, track time, and material causes us to become very aware of these problems and the need to perform the proper maintenance. Once we are aware of the problems we can then begin to prevent or repair, extending the life of these valuable assets.

Thank you. (Applause)

Mr. Horney: Mr. Leroy Davidson will introduce the next two presentations.

Mr. Davidson: At this time I'd like to introduce Mr. Glenn Ebling of the Southern Group for an update on timber.

STANDING COMMITTEE REPORT:

MATERIALS

Glenn Ebling

Southern Group, Inc.

Azobe timber is a relatively new product to the United States. We have been using it for only three and a half years or so. The European installations are much older than that. The AAR has sponsored some tests that were done by the University of Illinois where they ran it through their accelerated aging cycle and I would suggest that if you are interested contact the AAR and see what their results were. It's tested out quite favorably to treated ties but that is a laboratory situation and some people don't hold too much stock in that as far as real-world type of application. In general uses cross ties, switch ties, high degree curves, any place that is very hard on ties where you have a typically short tie life, Azobe has a very good resistance to pull out. A typical cut spike is around 22,000 pounds pull out, we've seen up to 33,000 pounds resistance on screw fasteners. It's also very effective in holding gauge.

All types of bridge members, typically bridge decking, and some walkways can be used for bridge caps. The material is appropriate for any structuraal member. It can be used for fendering systems.

We have seen the best results on the KCS where we are doing pre-paneling of switches. Some people have identified it to be more appropriate for bridge decks. In the northeast part of the country we've had several inquiries from people where they're passing over waterways and where the various types of treatment would be a problem. Since this material can be used untreated it's very effective in those types of installations. It's not a magic product, it's not a cure-all, and it's not for every application. We don't advocate replacing every tie and every mile of track with Azobe but where it's called for it's very effective.

Since it's not produced domestically you do need to plan ahead somewhat in terms of availability. Price and delivery are both affected by quantity and final destination. The quantity variables, to use a poorly defined term, would be in shipload and less than shipload quantities. The economies of scale typically don't exist on single bridges or small loads of less than 50 cubic meters of material. The best way to look at it is on terms of high maintenance projects where maintenance costs are high and you don't want to go back versus the initial cost. The initial cost is higher. It is more expensive than domestic wood. What we recommend on a case-by-case basis, is that the user look at each case individually and see if it balances out.

With regard to installations that are currently in place, most of the Class Is have at least a test section of some size. A lot of the transit companies have installations and there is also quite a bit of pier construction going on. I have a piece of wood in the back that was cut out of railroad tie if you'd like to look at it. It's a small piece, I didn't want to carry a large one on the airplane. (Laughter) I'll be happy to answer any questions you might have regarding availability, general pricing or any other applications. Thank you. (Applause)

Mr. Davidson: Thank you, Glenn. I knew that would get everyone's attention. It can be worked in the field. It's harder but you can frame it in the field.

Our next report will be on B&B Training and will be presented by Mr. Jim Neece from CSX Transportation. We have just gotten into training on CSX in a big way. What we have in our presentation today today will be logged in with the Association office and be available if anyone wants it.

STANDING COMMITTEE REPORT:

B&B TRAINING

J. Neece

B&B Supervisor
CSX Transportation

Thank you, Leroy. CSX Transportation has four week training sessions for all supervisors in B&B. They meet one week each month for four consecutive months at the training facility located in West Virginia. The purpose of these training sessions is to instruct each supervisor in the correct procedures of performing his everyday duties, pursuant to CSX Transportation standard procedures and in a quality-like manner.

There are many subject matters covered during the four sessions. Some of these subjects are safety and operating rule compliance, tool identification and usage, bridge inspection, first aid, CPR, tie framing, vehicle safety, scaffolding, pile driving, concrete testing and repairs, scale inspection and maintenance, structural problems in bridges and introduction to computers.

The training sessions are conducted by facilitators from CSX Transportation's training facility. The facilitators are trained by the training facility instructor to facilitate these sessions and update the material they deliver to each attendee. A facilitator uses manuals that have been prepared by various CSX Transportation engineering personnel. These manuals are given to each attendee and become a valuable reference tool. At the beginning of the first classroom session each attendee is given a written examination covering various subject matters germane to his job. Each question on the exam will be covered during the four week training session. Upon completion of the training session, the same examination is given. The purpose of the pre and post exam is not to embarrass someone. It's a tool for the facilitator and supervisor. The supervisor will find the employee's weak areas and the facilitator will also know what areas he needs to stress more or less. The post exam also will give the facilitator an idea of how well he got the material across. The facilitator does not do all the facilitating himself. He utilizes various other personnel qualified in different areas such as scale engineer, members of the rule and compliance committee, Red Cross personnel, computer instructors, bridge engineers and bridge inspectors. Utilization of these people gives each attendee the opportunity to ask and receive answers to various problems he may have encountered in his everyday duties.

CSX Transportation has recently decided to carry this program one step further. This training is now given to B&B foremen and assistant foremen. The response from the people who have attended these sessions has been very good. Their on-the-job performance has also improved.

To conclude I have some slides I would like to show identifying the training session. I would also like to thank our B&B training facilitator for help in preparing this presentation.

(Whereupon there was a slide presentation of the West Virginia Training Facility)

President Tallent: Both parts of that presentation were very informative. If there's no further business, I'd like to remind you of the REMSA reception tonight at 6:30 at the Royal York and I look forward to seeing you all there.

This session is now adjourned.

WEDNESDAY JOINT SESSION

August 30, 1989

President Matte: Good morning everyone. We will now call this final joint session to order. Our thanks to REMSA for the wonderful and enjoyable reception last evening.

At 8:00 a.m. our registration stood as follows: 546 Roadmasters, 106 B&B, 550 Associates, 933 Guests, 472 Ladies, for a total of 2,607.

Our next speaker is Mr. P. R. Richards, chief engineer for CN in Montreal. Mr. Richards received his Bachelor of Science Degree in Civil Engineering from the University of New Brunswick and his diploma in Business Administration from Northeastern University in 1979.

Mr. Richards joined CN's engineering department in 1953 moving through various line positions to division engineer/area engineer, then to regional headquarters in research and development in 1966. He then went on to assistant engineer maintenance of way, production engineer, operations engineer, all in various locations in central and eastern Canada. He was promoted to system headquarters in 1976 as engineer of programming, assistant chief engineer track and roadway in 1978, and then to chief engineer in 1981. Mr. Richards is a former director of the Roadmasters and Maintenance of Way Association and past president of AREA. He is also a member of the Professional Engineering Association of Quebec. Please welcome Mr. Phil Richards.

HUMAN ELEMENTS DURING AND AFTER REORGANIZATION

P. R. Richards

Chief Engineer
Canadian National Railways

P. R. Richards

As a former director of this Association, I was pleased when I was asked to be your keynote speaker on the subject of human elements in reorganization. At these sessions, particularly when we have our friends, the suppliers, present, there is a tendency to concentrate on the technical and mechanical aspects of our work.

We are always looking out for new equipment that will help us do our job more efficiently and new techniques that will enable us to cut costs. But in the final analysis, the effectiveness of our output, and the quality of the track we maintain, depend more on the people working in maintenance of way at all levels than it does on the technology and the techniques we employ. You can always buy the technology and the training that goes with it.

But the real challenge is managing the human aspect during a period when we are implementing fundamental changes in the way we work to improve quality and safety, as well as cut costs to meet the increasing pressures of competition. We all know there is growing competition from trucking and other modes for every ton of freight we handle as a result of such factors as regulatory change and shifting market demands. We also know that rail is the only form of transportation that bears the full cost of providing and maintaining its own right of way.

To keep our rates competitive with those of truckers that have their rights of way provided by other agencies, often with only a nominal charge to the carrier, we have to control rigidly every area of expenditure, including maintenance of way. This means whittling down our trackage to a network in which every subdivision has sufficient traffic to justify its existence. We can no longer support large numbers of branch lines that were marginal even when rail was the only form of mechanized land transportation and now abandoned by shippers since the building of tax-supported highways.

It means turning to technology, the sophisticated new equipment and materials being developed by our suppliers, to do more work to higher standards with fewer people. Both these elements, reduction of the network and mechanization, make reorganization a fact of life in every major railway in North America today. And reorganization means fundamental changes for the people involved. It means downsizing of work forces, at both the blue and white collar levels. It means having to learn new skills, and new ways of carrying out familiar tasks, often for people who are past the midpoint in their career. It means having to change traditional attitudes and values and, in many cases, having people accept higher standards of output and quality. It can mean having to tell

people who have spent most of their lives working in our industry that, through no fault or failure on their part, they no longer have a job.

Dealing with these aspects of management is the most difficult challenge to roadmasters and others in supervisory and management positions in maintenance of way and engineering. Their training has not prepared them to deal as effectively with the human side as it has with the technical and operational demands of the job. But roadmasters and other maintenance-of-way people must treat the human dimension as an increasingly important part of their responsibilities.

Let me give you some idea of the scope of the reorganization we have undergone in maintenance of way at Canadian National over the past 20 years and its human dimension.

In 1969, we had more than 24,000 miles of track and a work force of 7,000 to maintain it. This year we have less than 21,000 miles of track, and a work force of 4,000. And we have just completed negotiations that will reduce the permanent track work force by a further 40 percent in October.

You will note that although our trackage has been reduced, the percentage of reduction in work force has been much greater. The challenge is to maintain that trackage with a much smaller, better equipped work force. The task is made even more demanding by the fact that the standards to which track must be maintained have been increased. Good track is the foundation to railway safety in every sense of the term.

Our senior vice president of operations, John Kelsall, put the issue in perspective when he said recently, "Safety is also a barometer of management effectiveness. A railway's safety record is a reliable indicator of the quality of its leadership, supervision, work habits, and environment, and a good safety record is usually accompanied by high productivity and good employee morale."

We all know the longer, heavier freight trains now being operated to increase productivity place an increasing burden on the track structure. We have seen heavier welded rail, concrete ties, improved ballasting, and other measures introduced to prepare roadbeds for these demands, but each one of these measures has brought new challenges for maintenance-of-way people. The whole nature of the work is changing. At one time, the basic equipment used was no more complicated than the ballast rake and maul, and the main requirement for employees was physical strength. Today, when you see the type of sophisticated equipment being demonstrated and discussed at this conference, you realize that our track maintenance forces need to have more than a strong back to carry out their jobs effectively.

To meet our requirements for improved safety and productivity, we need fewer but better trained track maintenance employees using the most efficient equipment our suppliers can provide. With the use of advanced track geometry cars, we can target the work of these employees to the areas where it is needed and monitor the quality of their work. At CN we are employing mobile gangs using larger hi-rail trucks equipped with cranes and making them responsible for longer stretches of track than was possible before. We have also experimented with helicopters for track inspections and to bring workers and track supplies quickly where needed.

Many of these changes have been difficult for maintenance-of-way employees who began their careers with the railway under a very different set of circumstances. They have had to learn new skills and take on new responsibilities. At the same time, they have seen their number depleted, and they are concerned about the security of their own future. At Canadian National we try to cushion the effects of change through such measures as early retirement, retraining, relocation, and other employment security benefits.

In these measures we work closely with the Brotherhood of Maintenance of Way Employees to ensure that the welfare of the employees is protected. In the most recent reduction that is scheduled to begin in October, we have negotiated a special agreement and changes in the existing contract with the BMWE to ease the impact on employees who will be adversely affected by greater mechanization. About 500 employees are eligible to retire early, or qualify for a negotiated deferred separation benefit. Other will have an opportunity for advancement. Qualified union members will be given preference in the appointment of 150 assistant roadmasters, and we are offering the equivalent of some 700 person-years of seasonal work.

Teams of company and union officers are meeting with employees in communities across Canada to explain the changes and the options available under the special agreement. Among the benefits are a significantly improved lump sum separation allowance, and continued group life insurance and extended health care coverage until age 65 to facilitate early retirement by some 300 eligible employees.

The deferred separation plan will provide 65 percent of salary for some 200 employees who are at least 50 years of age, and who are within five years of eligibility for early retirement. Employees taking early retirement or deferred separation options will receive financial counseling at company expense. Those who cannot hold work under the terms and conditions of our employment security and income maintenance plan will receive layoff benefits of up to 80 percent of salary for up to five years, depending on length of service. We are offering training and better paid job classifications to employees who double as track maintainers and drivers of boom and frog trucks.

I have given details of this special agreement to illustrate the measures we take in conjunction with unions to ease the impact on maintenance-of-way employees of work force reductions stemming from mechanization.

One of the concerns that is always raised when there are reductions in maintenance-of-way forces is the safety of the operation. As I indicated earlier, safety is of primary concern to everyone at CN. I believe it is a great credit to the maintenance-of-way people of Canadian National at every level, that throughout all this period of change and reductions, we recorded a steady decline in both train accidents and personal injuries. In fact, in 1988, Canadian National was one of the top two safety performers in the entire North American railway industry, with 3.12 personal injuries per 200,000 work hours, and 2.48 train accidents per million locomotive miles.

It would be a mistake to leave you with the impression that maintenance-of-way reorganization affects only unionized employees. It has had an effect on the size of management and professional staffs as well. We have, in fact, removed an entire level in the management structure. At one time, we had area staffs that reported to regions, that in turn reported to headquarters. Now we have divided our system into 11 districts that are responsible for 1,000 to 3,000 miles of track each.

We have also redirected more of our engineering design and other professional requirements to outside sources rather than staffing up to meet all our needs internally. With the increasing complexity of our work, it is not cost-effective to maintain a large engineering group covering all the specialties.

These changes have had an impact on the career development and opportunities for advancement of the professional and management staffs remaining and new entrants to the industry. The work environment for the management and professional employee has changed just as much as it has for the person working on a track gang. Only the nature of the change is different.

What we need today at all levels are more people who are not resistant to changes, or have their horizons limited by narrow professionalism. What we need are people who can see maintenance of way, not as an end in itself, but as an essential element that must be managed effectively as part of a highly competitive business. Everyone in the management and professional end of maintenance of way has to be aware of the need to contribute to the bottom line of the business: in other words, they have to be market-oriented.

Looking to the future, the only thing we can be sure of is that the pressures of competition will increase, and this will mean ever-increasing demands to manage more effectively and produce better results with fewer resources in terms of money, materials, and people.

I hope that in dealing with the challenges facing our industry today, I have not left you with the impression that the outlook is bleak. I believe that the railway industry in North America has a bright future, particularly as we further develop continental traffic through such measures as the recent Free Trade Agreement between Canada and the United States. Our two countries are each other's largest trading partner, and we need to build on that relationship for the economic benefit of both nations.

In the long term, provided we take full advantage of the new technology and techniques available to us, the efficiency of the steel wheel moving on the steel rail will win out. But the quality of that steel rail depends on efficient and effective maintenance of way. That's where we

come back to the human element.

One of the factors that has given me the greatest confidence in the future of the railway industry is the caliber of people who are coming up through the ranks as roadmasters and other management and supervisory people in maintenance of way, the people who are represented here today.

Delegates, the future of the railway industry is in your hands. I believe this Association is playing a key role in preparing you for the task by bringing together maintenance-of-way people from across North America at conferences such as this. Here you can learn about the latest technology and materials being provided by the railway supply industry to help us do our job better. Here you can meet with colleagues who face the same problems that you do and learn about the techniques they have developed to resolve them. This exchange of information is of benefit to all concerned. Reorganization can be a challenging process. But like steel that comes through the fire, the result is a stronger product that can stand up better to the demands of the railway industry.

Maintenance-of-way people are the steel backbone of the railway industry. Today's challenges give you the opportunity to show us your mettle. Thank you. (Applause)

Mr. Koff: Thank you, Mr. Richards. We appreciate that interesting talk. I'll now ask John Horney to introduce our next presentation.

Mr. Horney: Thank you, Ken. Our next presentation is a special feature, "Explosive Demolition of Structures". It will be presented by Mr. Warren Stephens. Mr. Stephens has had over 22 years of extensive experience with explosives for both the government and private sectors. He has literally written the book on standardization and qualifications for explosive ordinance. He is now with GOEX, Incorporated, as their expert in structural demolition. Please welcome Mr. Warren Stephens.

EXPLOSIVE DEMOLITION OF STRUCTURES

Warren Stephens

GOEX, Incorporated

Thank you, John. Good morning ladies and gentlemen. I'm pleased and honored to be here. GOEX, Incorporated and I appreciate the opportunity to address such a distinguished audience.

Today I have come to speak to you about the use of explosives, especially the use of precision-shaped charges in the industrial sector of today's world. I would also like to try to dispel the apprehension regarding explosives that still surrounds us today. Try to imagine for a moment a bigger-than-life hollywood actor, maybe Clint Eastwood or Lee Marvin, or the meanest of mean, Jack Palance, lighting a fuse on a stick of dynamite and blowing away what amounts to the entire mountain range with men flying skyhigh and rocks tumbling everywhere. Or how about the scenes that show people using nitroglycerin to blow a bank vault. Invariably, something goes wrong. Everybody comes unglued and the money is floating all around in the air. At one time my wife refused to watch an action-packed movie with me, and when I asked her why she told me that every time something exploded I would critique every aspect of the scene and end the critique when the explosion occurred with the words "that was salted". Well, I've had to curtail my running narrative of explosives and explosive techniques in my home, especially when watching a movie. But today I would like to convey to you and stress upon you the safety, and reliability, and predictability, of our precision-shaped explosives.

Think for a moment what explosives have done for us in our everyday life—our cars, lawn mowers, airplanes, just things that we take for granted. We take for granted the safety factors installed by the engineers. Gasoline is probably more dangerous and more explosive than explosives themselves. If you'll think about it, the engine of your car is in one end, and your gas tank is in the other. If you follow your lawn mower manual, it tells you to let the mower cool

STEVE

for 30 minutes after it runs out of gas before you start it again. There's reason for that. It's dangerous, more so than explosives.

Let me set up a scenario for you. A new bridge has been built, and it's time to dispose of the old one. The person in charge of this assignment has two ways to go. One is the conventional way with men, trains, torches. The conventional way, no doubt, has its advantages. However, it also has its downside. Aside from the time and monetary expense involved in these kinds of operations, the human safety factor is of primary importance. Both ways are hazardous but the conventional way can be very dangerous. Cutting metal support members that are under tension and stress can be quite unpredictable and is responsible for most of the accidents associated with this type of work. The second option, the one we hope the project manager will consider, is contract with a reputable certified explosive company, and get the job done safely in less time with more predictable results.

Up until recently, explosives were used by the military for total destruction without thought of what the EPA would say. And today EPA has plenty to say. But now high explosives have been corraled and are being used as a reliable tool in the demolition business. Explosive charges have been engineered to give controlled performance with less explosive loads. The explosive load is now pressed to a high density and shaped to focus the explosives wave to allow a precise and predictable cut. The results are much the same as using a cutting torch, only the cut is performed remotely and without fear of personal injury. This shaped explosive charge is called linear shaped charged, LSC, and GOEX is only one of the three LSC manufacturers in the country.

I have prepared a slide demonstration on the demolition of a bridge in Louisiana by GOEX technicians, using GOEX manufactured LSC. But before I go any further, I must tell you before any structure is removed by our team of technicians a detailed demolition plan is submitted to the prime contractor, with copies of this plan sent to the state authorities, such as the highway department, and if there are any types of waterways involved, the plan would also be submitted to the Army Corps of Engineers and the coast guard.

Now let me give you some background information on the bridge that we'll be viewing. The bridge was a 1500 foot multi-span through truss over water. Since the bridge was spanning a navigable river, there were many factors that had to be taken into consideration and coordinated for the success of the job. The Coast Guard required the removal of the bridge from the waterway within 48 hours. The prime contractor had two barge mounted cranes available. One was a Manitowac 4100W, the other a Manitowac wringer crane. The maximum lift capability of the crane was 40 tons. The bridge spans were calculated to weigh 500 tons so we had to cut the span into 14 pieces, weighing approximately 30 tons each. This presented no problem to us, because we had the capability to cut the bridge in as many pieces as the prime contractor wanted. The Coast Guard's requirement of 48 hours was the deciding factor. The prime contractor decided that we would cut each span separately of each other due to the unforeseen mechanical breakdown or poor weather. When you're on a time schedule, generally all of the above happens. We have found that cutting down a bridge in this fashion means less entanglement on the bottom of the waterway which enhances the retrieval of each sectional cut. If the bridge had been land based we would have opted to take it down at one time.

As we know, reliability is one of the main things we all strive for, no matter what the job might be. As you will note on the next couple of slides we have the new bridge separated from the old bridge by a distance of 80 feet at its closest point. When the crew came on board this was the first look they had at the bridge.

Shown here in the waterway we have a tugboat maneuvering a barge carrying a crane. Looking at the bottom left of the barge you can see the buoys that are to be attached to each sectional cut to mark them and make the retrieval after demolition much easier, less time consuming and, of course, much safer. The buoys also eliminate the need for underwater divers. Using divers in a situation like this is very dangerous due to the sharp cut steel, no visibility, and strong current.

This is the bridge before we went to our demolition plan and marked it for precut.

Now that the equipment is in place the bridge is marked off in numerical order according to the demolition plan. As you probably already noticed the numeral two is pretty hard to do up

side down, even after several tries. (Laughter) With the help of a basket on a crane, the marking of what is to be precut is done. Now the work begins.

Here the top of the flange is being precut with a torch to facilitate the access to the web where the LSC will be placed. We use torches to precut the flanges to create access holes through which to place the LSC, all the while keeping in mind the load bearing of the bridge.

These gentlemen right here are putting up the safety wires that will be attached to the workers as they place the LSC.

Here we see the access holes, and if you will note right there, we usually cut it at one end. That's to insure when the bridge is shot, it will fall. I've seen some places where they didn't leave that cut, and the bridge doesn't fall. The shot's made, and it's still standing. All it does is work against itself and stay there. You people do a good job building a bridge.

This is the staging for the explosives. All the precutting has to be done on the first span, so the explosives were brought to the first span to be shot. The containers you see are what we call day boxes. These containers are approved for temporary storage of explosives at the job site.

Here you see the technicians going through the LSC which is the copper covered explosives that have been precut at our GOEX plant at Cleburne, Texas, according to the demolition plan. What resembles white rope is called primer cord. The primer cord is what is used to initiate the charge. This right here is what most of us know as the copper pipe. It is annealed and it's shaped and the explosives are pressed in. This is what is called the primer cord.

The technicians are now attaching the primer cord to the LSC. Nobody is smoking, but nobody seems to be worried about it either.

Here is a good view of the LSC and the bag that is used to carry it out on the bridge. This is the project manager, and he is going over the LSC to make sure that it is put in the proper place.

Once again I would like to stress the safety factor in this operation. As you can see, much like a pilot goes over his checklist for takeoff, we carefully go over ours.

The next few slides will show the placement of charges.

This is the access hole and this web is where we cut. The linear will be placed on the inside to cut this web right here. You have to be a monkey to do this too.

Here is the LSC placed. This little black thing you see right here is what we call a "stand off". In order for the shaped charge to get started and to cut, it needs this air gap. If we were shooting under water it would have a water tight cover around it so that the jet would form. This is a piece of the LSC and, as you can see here, this is the precut piling and of course, this is a little bit bigger than one inch. This would be under stress or tension if it was cut by a torch and it's liable to go anywhere.

This is the placement of the final charges and the uprights. This slide shows the placement of charge that will be tied into the primer cord trunk line for this shot. At this point, there are only two technicians on the bridge. All other personnel are located in a safe area and posted as guards to insure that absolutely no one other than authorized personnel is in the explosive area. You'd be surprised at how many people hide out behind a bush and take a picture of this because it doesn't happen very often. Safety is our primary interest.

This is a picture from upriver just prior to the shot. This is the shot, and each one of those little puffs of smoke is where a charge has been placed. And the fall. As you can note in the background the new bridge is right there.

As I said in the beginning, the results are predictable as you will see in the following slides. A charge such as this will have these results. You can see the clean cut that the charge does. I doubt seriously that as many burners could do the job as well and as fast.

That's a pretty clean cut. Every place that you see a cut is where a linear was placed. As I said a piece of linear such as this has the result of this. You can see bulk explosives haven't been used here because of the clean cut. Bulk explosives have their place in the demolition business but not with cutting steel. If you use bulk explosives to cut steel it would all be bowed out right through here. It doesn't cut it, it breaks it, which causes shrapnel and a lot of damage that you hadn't planned. So LSC is used for cutting steel.

This house was 1,100 feet away. What you have just seen is a quick overview of the demolition of a bridge. Much the same procedure is

involved in the explosive demolition of a steel building or steel structures in the conventional building. Perhaps some of you are wondering just how much explosive material it took to take that span down. Each span was taken down separately with approximately 80 pounds of explosives and there are 400 individual charges of various lengths. That 80 pounds of explosives had been placed in different locations on the span. Now if I were you, I would be thinking that 80 pounds is quite a lot of explosives to detonate at one time. My answer to that is, "Not really", because the detonation of this 80 pounds is cut 33 percent by using three different delay caps. All this 80 pounds was initiated at one time. The charges had predetermined delays before detonation. These delays serve two purposes. They cut the explosive weight detonated at one time plus reduce the peak particle and peak over pressure, and they give milliseconds for the bridge to fall in the order and direction that we desire. By the way, that house was located 1,100 feet from the closest charge and suffered no damage. A standard developed by the Bureau of Mines is that a single detonation of 95 pound charge suspended in the air will break windows and small light bulbs in a radius of 237 feet. We used 80 pounds and further reduced it to 27 pounds per delay. The complete bridge was cut into 51 pieces. There was a total of 1,262 individual charges detonated, the total weight of explosives was 263 pounds, using 464 electric caps. The calculation of explosives per ton of steel was 5.17 pounds. The surrounding structure suffered no damage. The new bridge which was 80 feet away suffered minimal paint chippings.

The technical use of explosives is finally coming of age. Today's explosive safe charges in the hands of skilled technicians are safe, predictable, and reliable. At GOEX, we not only have skilled technicians but we also have a full time explosive engineering staff that constantly strives to lead the ever-changing technology of precision explosives. Explosives can be used as any conventional cutting tool and offers what we believe to be a safe and economical service. Thank you for your time and I've enjoyed being here. (Applause)

Mr. Horney: Thank you, Warren. I appreciate your seriousness on safety. To present our next special feature on the Channel Tunnel Project I'd like to introduce Mr. Patrick Dronier of the Vape Company Mr. Dronier is chairman of AREA Committee 12 and is manager of railway and civil engineering products for Vape Company.

CHANNEL TUNNEL PROJECT

Patrick Dronier

Vape Company

Good morning, ladies and gentlemen. First of all I would like to thank the American Railway Bridge and Building Association for giving us the opportunity to present the Channel Tunnel video. We hope this video will cast a bit of light on what is going on between France and Britian.

During the 19th century the idea to bore a tunnel under the Channel gave way to many original, different and picturesque proposals. That of Tomay de Gaamon, who bored more than 100 feet deep for his research, appeared to be the most serious and was the basis for the formation of financial groups in Great Britain and France. In 1882 important preliminary works were undertaken between Cape White Nose and Sangatte.

In 1959, three quarters of a century later, the study group of the Channel Tunnel proposed a project with two railway galleries. The preparatory works were started in 1972. But in 1975, the project was abandoned for financial reasons.

The solution of the tunnel was preferred to bridge or bridge-tunnel projects. This tunnel will link England to the rest of Europe with a total length of 30 miles, 23.5 of which will be underground. The work will consist of a central service tunnel which will be used for inspection and gallery works, and two railroad tunnels, 100 feet apart from one another, axiswise.

Both railroad tunnels will be linked every 800 feet with pressure relief ducts to reduce the dynamic drag of trains, and the three tunnels will be connected every 1,230 feet by cross passages for passenger evacuation in the service tunnel in case of an accident. The trains will run safely on one-way tracks.

The tunnel will be bored in blue chalk, as it is the most waterproof, between 80 and 165 feet under the bottom of the sea.

In 1989, an additional subsurface investigation of the submarine geology was started. A platform was erected which can operate from 30 feet to 300 feet deep. Analyses are done on ten samples core-drilled between 200 and 330 feet from the bottom of the seal, with a continuous sampling giving a geological description, a geotechnical classification and the possibility to measure waterproofness on site.

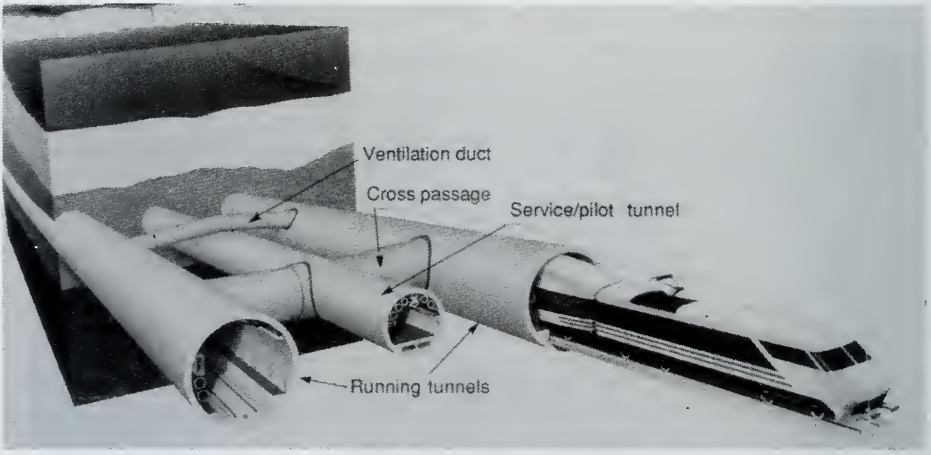
Vertical seismic profiles have also been undertaken in six of these samples to improve the geophysical measurements done from the surface of the Channel. The surveys carried out in 1858, 1954 and 1973 complemented by this latest investigation allows the builders to create a very precise tunnel layer.

On the French side, the final Channel Tunnel facilities will be located in Coquelles on a 86 acre area connected to the French railway network in order to preserve the site of the cliffs. So that the submarine section of the tunnel can be bored at the earliest, without waiting for the French underground to be bored through extremely porous chalk layers, the construction of the access has been started close to the seaside. This way the tunneling machines could go down and the spoils can be evacuated.

At the beginning of 1987, Sol Etanche was given the task by the contractor TML to make a waterproof barrier. This barrier consists of a first wall bored into the ground down to the level of the blue chalk, 200 feet deep on an elliptical layout 1650 feet wide and filled with bentonite. A second wall was made of cast reinforced concrete with a diameter of 190 feet, 66 feet deep, and 31 inches thick. Both these constructions have been made with two hydromills. Thus protected by the concrete wall from water infiltration, the excavation is done from point plus 18 down to minus 3. It goes down with a three-foot thick protection wall in reinforced concrete cast in place.

In order to prepare the assembly sites and the passage of the tunneling machines, the well reached point minus 30 during spring of 1987. The beginning of the service tunnel and the two railroad galleries, on both sides sea and earth, could be excavated on a length of 165 feet, and

Shown are some of the segments of the 40,715 concrete rings that will line the French part of the tunnel now being built under the English Channel.



Channel Tunnel's rail tubes will lie 98 feet apart with a service tube in between.

were completed with a 40 foot long cylindrical chamber in which the skirt of the tunneling machine came to fit at the time of the assembly.

With a 70 square meter section and a 36 foot opening for the stations of the service tunnel and with a 1200 square foot section and a 43 foot opening for the stations of the railroad tunnels, the excavation was done by areas, first the arch, then the lower half sections.

Once the excavation of the interior part of the well was finished, in this space where the Arc of Triumph could stand, a real underground plant has been set, thus permitting the movement of personnel, material supplies, evacuation of soils and infiltration waters, and ventilation.

During September, at the station level, 600 foot long main beams were laid; the metallic floor as well as the rails for the tunneling machines were installed on four buttressing pillars with a 6.6 foot diameter, anchored in blue chalk, thus leaving vacant the interior part of the well used for mixing and pumping the spoils and the water collection.

The three tunnels are about 19 kilometers each on the French side, and are covered with precast reinforced concrete cylindrical rings. Each ring is made of six liners. A large site, with three main areas, has been set up for the precasting of the tunnel liners: an indoor shop for reinforcing bars covering 100,000 square feet; a casting shop of the same area; and an outdoor storage area covering 260,000 square feet. During 1987, TML began the necessary work to enable the fabrication to start early in 1988, and the plant reached its current fabrication rate in October, 1988.

After shutting the form, the PLASTIRAIL inserts are positioned on their support. During the construction of the three tunnels, the PLASTIRAIL inserts will be matched with their bolts, thus constituting the connecting system of the liners, on the one hand, and of the rings on the other hand. A total of more than a million PLASTIRAIL sets will be used for this application.

In order to make the precast of 225,000 tunnel liners, the casting shop has five production lines, two of which operate for the service tunnel, and the other three for the railroad tunnels. Each production line is a carousel of 44 molds fed by an automated concrete plant with 160 cubic yards per hour.

Different working tasks are distributed along each line where a wagon assures the rotation of the molds at both ends. The return of the filled molds is done in a drying tunnel which accelerates the hardening process of the concrete and allows the liners to be stripped from the forms after eight hours. Once out of the form, the liners are deposited on automated wagons where they are marked, rerigged, and jointed with neoprene. The plant works with three shifts and can produce a liner every two and a half minutes. The liners are taken by truck to the 660 foot long storage area and piled up according to their type and age.

On January 28, 1988, everything was ready to welcome the first tunneling machine delivered on the French side in Calais harbor, thus marking the real start of construction.

Supplied by the Robins Company of Seattle, the first tunneling machine weighing 475 tons assigned to the service tunnel was transported from Calais to the site of Sangatte in less than six hours on a special route. It was followed by four other Japanese tunneling machines to bore the different galleries.

A gantry with a 275 ton capacity allowed the tunneling machine to go down on the structural steel floor of the well. This later operation required about ten working hours before the machine reached the front of the service tunnel to bore. This pilot tunnel allows inspection of the structural layers of the ground, and to dig the pressure relief ducts and the cross passages. The objective of this first tunneling machine was to bore a 10-mile service tunnel on the sea side.

With a 900 foot length and an approximate weight of 880 tons, the tunneling machine is made of a 17-gantry train, the first being the machine itself, then the piloting area, the supply gantries for tubing, rails, energy, compressed air, the gantry for the grouting material used to fill between the tunnel liners and the ground and the transfer gantry for the complete rings. It was on February 28, 1988, that the effective start took place.

The chalk is pulverized, mixed, and pumped directly to the outside from the tunnel machine. Later on, when the whole service train of the tunneling machine has advanced beyond the well areas, the chalk is transported by freight cars.

Gradually the tunnel liners are carried in

The Channel Tunnel access well at Coquelles, France, is 190 feet in diameter. The crown of the two railway bores and the central service bore are shown.

whole rings to be laid inside the skirt of the machine. Two independent erectors, equipped with suction grips and able to rotate by 360 degrees, seize the liners to put them in place up to form a complete six foot wide rang, which constitutes the final coating of the tunnel.

Once in place, the tunnel liners are maintained by jacks. It is at this time that the PLASTIRAIL bolts are screwed in, thus compressing the neoprene joints in order to guarantee waterproofness until cementitious grout is injected. Each ring is composed of three bearing liner sections, two counter keys and one key.

The EUROTUNNEL shuttles will alternate with passenger and freight trains of British Rail and SNCF, notably the TGV North. With EUROTUNNEL, cars, buses, trailers, trucks and even individuals will safely ride under the Channel at 100 miles per hour for a 33 minute trip. The tunnel opens the way to unrestricted travel.

Thank you.

President Tallent: Thank you for that very informative video. I'm sure there are some people with questions, and if you're available during break I'm sure they'll look you up. Mr. Jim Michel will introduce our next presentation.

RECONSTRUCTION OF STANWELL PARK VIADUCT

Paper and Video prepared by M. J. Hickey

Construction Project Engineer
State Rail Authority of New South Wales, Australia

Introductory Remarks by J. M. Michel

Senior Director Engineering, Amtrak

Introduction

The following video was originally presented at the Institution of Engineers-Australia Railway Engineering Conference in Perth, Australia, in 1987. The conference theme was "Productivity". There are many ways to improve productivity, but none is more effective than responding to a natural disaster, when heroic efforts are made by many to simply get the railroad open again. The reconstruction of the Stanwell Park viaduct is one of those stories. It represents a unique set of challenges to the railway engineers of the State Rail Authority of New South Wales to restore essential train service over a key bridge on the Illawarra Line south of Sydney. This line handles considerable coal traffic to the steel mills and docks at Port Kembla, as well as substantial suburban and intercity passenger traffic between Sydney, Wollongong, and Nowra.

The State Rail Authority had been working for over two years to electrify 27 miles of the Illawarra line, by improving clearances, constructing catenary structures, and rebuilding track structure. The Stanwell Park viaduct was constructed as an eight arch brick viaduct built on a double track curved alignment of approximately 750 feet in radius. The structure is 150 feet above the streambed. The following slides show some of the original construction. The bricks were actually fabricated on site because of the remote location of the work site in Royal National Park.

On August 14, 1985, cracking was noted on the floor of arch No. 3. Some remedial work was undertaken to reduce the side load on the spandrel walls and tie rods were installed. On December 8, 1985, the northbound track had to be closed because of loss of brickwork in arch No. 6. On December 12, only three days before the grand opening of electrified service, including political ribbon cuttings and major media coverage, the viaduct had to be closed to all rail traffic. The immediate problem for the engineers was how to repair or replace the viaduct without knowing the cause of the problem or whether any steps to be taken would be effective. Compounding the decision-making process was the high sensitivity of the service interruption to the traveling public and the concern of political officials responsible for overseeing the rail system. The following video shows the extent of the repair job and the unique structural solution used to stabilize the bridge. The alternate title for this video might better be called "How to Investigate, Design, and Construct a Bridge in under Eight Weeks with No Plans, Materials or Information when Everyone is Shut Down for Christmas Holidays".

(Whereupon a video was shown with the accompanying remarks)

This paper provides the details of emergency repairs to Stanwell Park Viaduct between November 13, 1985, and February 4, 1986. Particular attention is given to replacement of a brick arch with a concrete structure.

The viaduct is/was? a magnificent structure of eight arches and has an overall length of 148 meters, minus a very critical 235 millimeters.

It is built on a 240 meter radius curve, and the track is some 45 meters above ground level at its center as it passes over Stanwell Creek. The viaduct is of brick skin construction (brick being manufactured on site) with rubble infill and then stone parapets. Arches are 13 meters in diameter.

Up until August 1985, the viaduct was in very good condition with no visible evidence of any major deterioration. On August 14, 1985, cracking was noted in the floor of No. 3 arch. Remedial works were carried out to this span. Work included lowering of both tracks to relieve the spandrel walls of side pressure and installation of tie bolts with vertical support to brace the span. These works were completed in September, 1985.

Regular monitoring of the structure continued and on December 8, 1985, the up track was closed due to loss of brickwork from the arch in span 6. One December 12, only three days before the proposed opening of the Illawarra electrification, the viaduct was closed to allow repairs and further investigations as to the cause of the damage.

The immediate problem became how to repair the viaduct as quickly as possible, without knowing the real cause of the failure and what further damage was likely to occur. This was later expanded as to how to investigate, design and construct a "bridge" in under eight weeks with no plans, materials or information, and when manufacturers and contractors are closed for the Christmas holidays. While the task may sound daunting, staff and contractors on the Illawarra electrification project were used to such challenges and suitably rose to the occasion.

Design and Construction of Falsework Support

Design of Spans

It was initially determined that the design for the span 6 repairs had to:

- Provide sufficient strength to fully support the damaged arch in span 6 so as to allow train traffic to be resumed as soon as possible. The residual strength of the brick arch was to be (conservatively) ignored.
- Be able to be constructed as fast as possible with materials which were readily available.

Features of Layout

The features of this layout are as follows:

- Acrow Panel units formed into support towers from ground level to springing level of the arch. These towers were braced together and then made stable as a group without support from the adjacent viaduct piers.

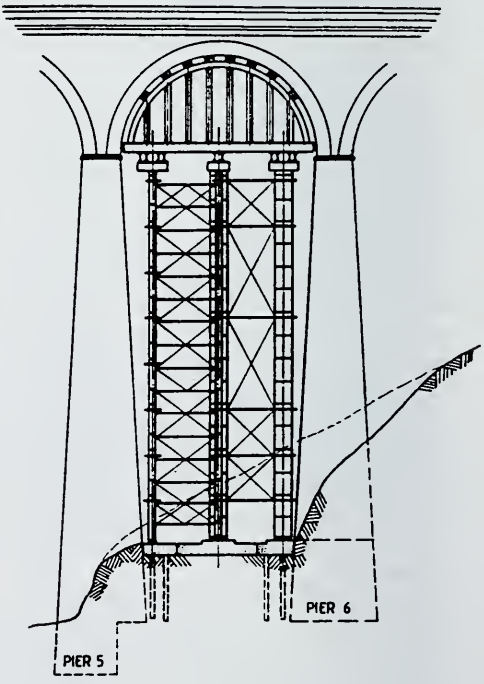
As there were limited stocks of bracing panels available for the standard two-panel tower configuration, some tower sections were configured as through sections with connecting transoms, etc., and used on end.

- A horizontal steel platform just above arch springing level. The main purposes of this platform were firstly, to act as the means of transferring the loads from the arch support frames to the tower sections and, secondly to act as a strut preventing the sudden closure of span 6 in the event of failure of the arch span.

A secondary but also significant benefit of the platform was derived from its use as an access to all subsequent repair work on the span.

The platform was constructed almost entirely using 610 UB 101 sections (in pairs), which the contractor had immediately available.

- Curved steel arch support frames supported on the platform and, through timber packings up to the brickwork, directly in contact with the arch soffit. Six pairs of support frames were used, the curved members being 150 UB 38 sections rolled to a 6.15m radius.



SPAN 6 — FALSEWORK LAYOUT

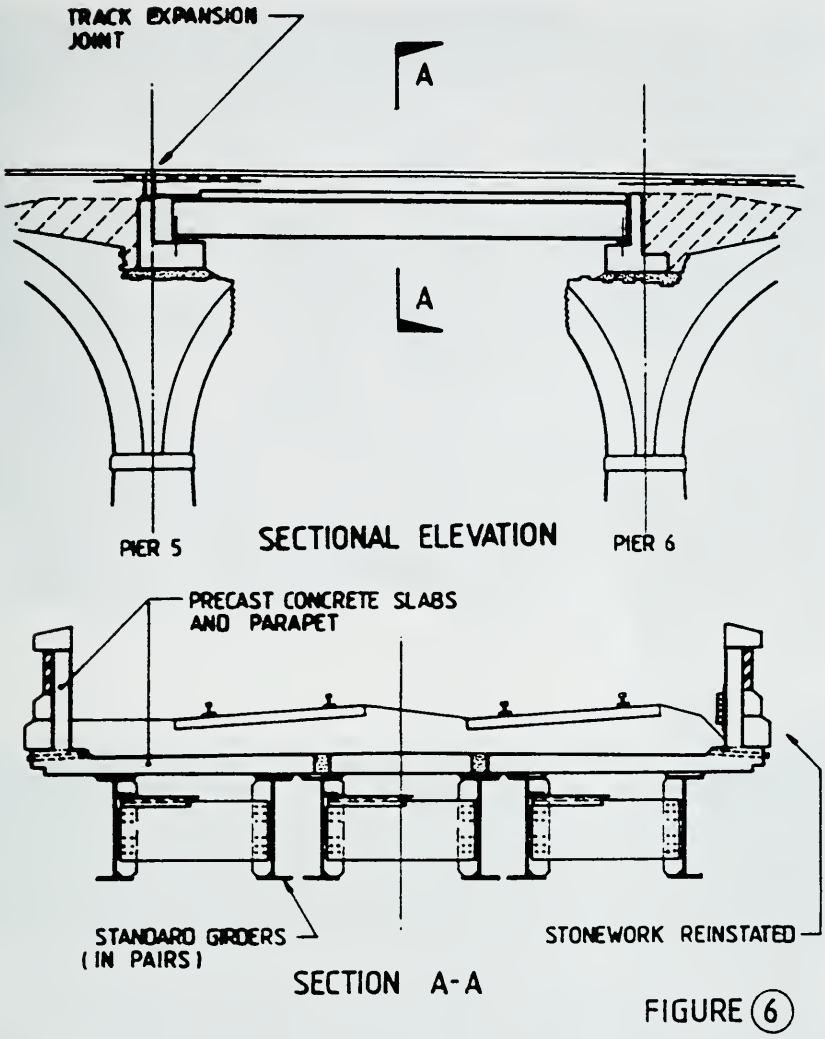


FIGURE (6)

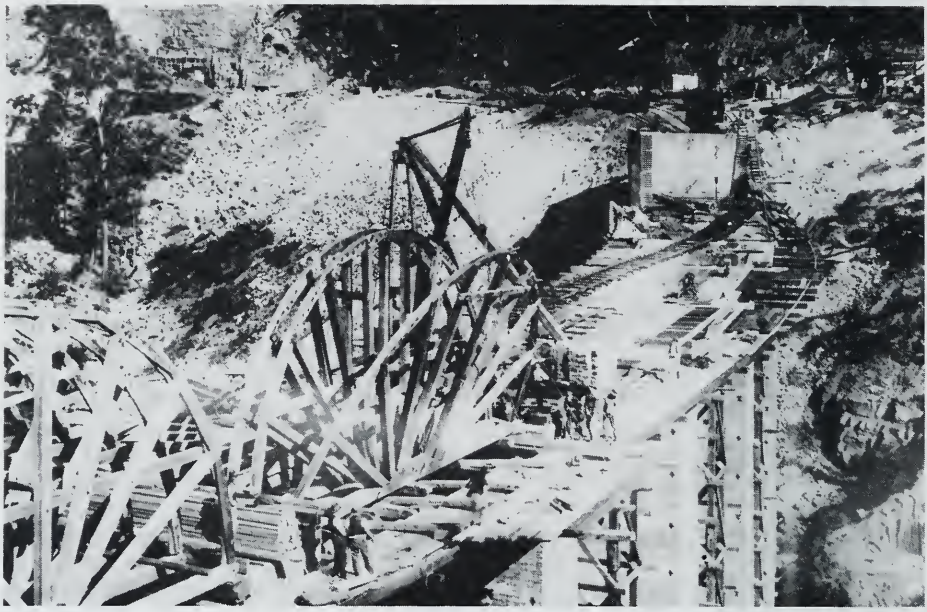
RECONSTRUCTION OF SPAN 6

Tower Footing

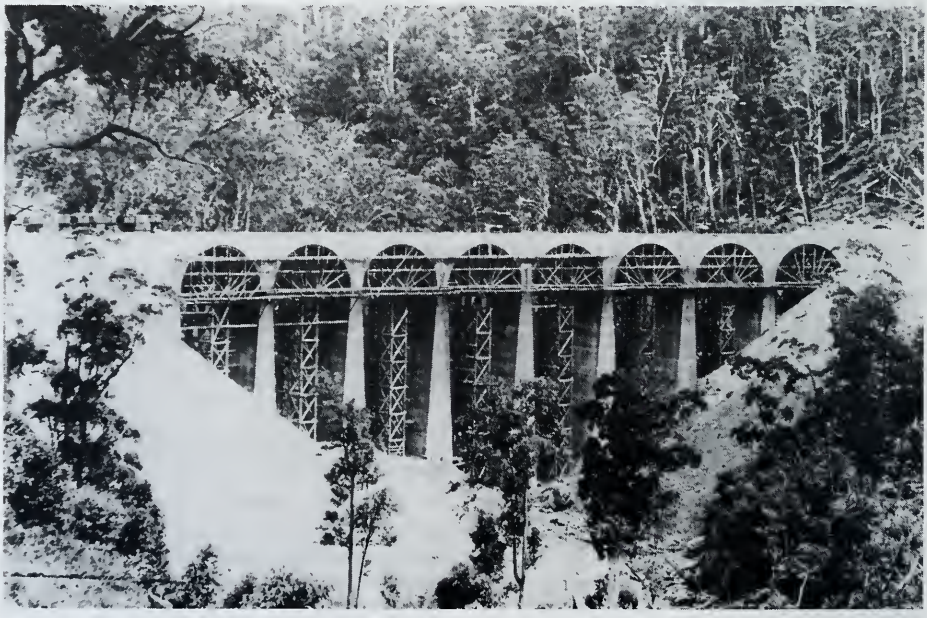
It was initially intended to support the tower on spread footings taken down to the same bedrock that supports the viaduct piers. However, initial excavations within the span uncovered the original foundation slab used to support the falsework during construction of the bridge almost 70 years earlier. The slab covered the central area of the span. A drill core taken through and beneath it showed it to be in good condition and well supported on rock, albeit containing clay seams.

As removing the slab would have taken too much time, it was decided to use it as the foundation for the three central towers and piled footing at the same level to support the outer towers.

The piled footings were designed on the basis



Formwork for arches being assembled.



Arches being constructed.

of four piles per tower, using galvanized 250 UC sections being obtained from the supply of overhead wiring structures on site.

As the arch above limited the size of piling hammer that could be used, the contractor expressed some concern as to the capacity being achieved from the piles. Accordingly, Maunsell utilized their pile driving analyzer equipment to test the piles, and as a result, additional piles were introduced under two towers.

A grillage of steel beams (250 UC 64) was placed across the top of the composite foundation before tower erection began, to distribute tower leg loads.

Falsework System

After the design and construction of the falsework system had commenced, it was further decided to take the opportunity afforded by the track closure to demolish the damaged arch and replace it with steel girders. (Figure 6) This decision was taken because the structure was still moving and no definite date could be given as to how long emergency repairs would suffice. There was the added advantage of having already mobilized staff, plant and materials on site.

Jacking System

As part of the planning of the demolition process, it was necessary to introduce a hydraulic jacking system into the struts at platform level. These jacks were designed to allow the controlled and progressive movement together of pier 5 and 6 as the residual compressive load was released from the arch.

Two 90 ton jacks were installed at one end of each of the twin 610 UB 101 strut sections with 150 millimeter of packing plates centrally placed. Between each jack pair a 150/180 ton packing release jack was inserted. The far ends of each strut were packed against the brickwork.

This jacking system was designed to work as follows:

a. Prior to demolition commencing, an initial load of approximately 50 kN to be set in each of the 90 ton jacks with pistons about 75 millimeter extended.

b. The jacks to then be locked off and hydraulic pressures monitored as demolition progressed.

c. If jack loads reached 750kN, the packing release jack was then to be activated, the 90 ton jacks released, some packing removed and the jacks reset at 50kN and the packing release jack deactivated.

TV Monitoring Systems

All jack hydraulic lines were taken up to a console located above pier 7. At this point it was possible to regularly record all jack pressures. Continuous visual monitoring of the jacks was carried out by closed circuit TV cameras, as it was judged to be unacceptable to have construction workers stationed on the platform while brickwork demolition was proceeding above. Six cameras were installed with lights, so that filming could be performed on a 24 hour basis. Cameras focused on the alignment of the jacks against the archwall to ensure jacks stayed in correct alignment and did not kick up. Cameras were also focused on the hydraulic gauges to measure the pressure in each set of jacks.

Gauges

An extremely elaborate measuring device (consisting of a lump of rail on a pulley) was placed across the up and down side span 6 to measure the relative closure/opening of the span as demolition took place. Cameras were also focused on this apparatus.

A switching mechanism was used with the cameras so that it automatically went from one camera to the next in sequence every five seconds. In addition, the view from one camera could be fixed on TV screen A, while the switching continued on screen B.

This system proved extremely valuable in assuring staff (and supervisors) that demolition was proceeding as planned. In practice it was not necessary to utilize the packing release jacks. As demolition proceeded, the maximum load achieved in the 90 ton jacks was 300kN/jack coupled with a span closure of five millimeters. Some fluctuations of jack pressure across the span width was experienced on a daily basis, but this was a result of temperature effects. Thermal effects were of the order of 60kN.

Tie Bars

As the demolition of span 6 was going to result in the severing of the previously continuous multi-span arch structure, it was necessary to provide restraint for the arch com-

Arches under construction.

Construction of arches. Note temporary trackwork in foreground.

pressive forces terminating at pier 5 and 6 respectively. To achieve this, tie bars were installed just above springing level in all the remaining arch spans. Four 38 millimeter diameter VSL prestressing bars were used per span, each bar being tensioned to an initial load of 250kN which was calculated to exceed the dead load thrusts in the arches.

These tie bars proved extremely difficult to install. Holes for the bars had to be drilled nine meters in depth through bricks and rubble and bars inserted, on average 30 meters above ground level, 10 meters below the deck, and underneath the arches on a workface nine meters in length.

Installation was achieved by converting the job of a crane to a swinging stage/work platform, which was supported in each span by a pidgeon pair of crawler cranes. This procedure required special D.I.R. approval. The swinging stage was inserted into each span using a 74 ton capacity crane or, in some cases, two 25 ton capacity cranes. The 38 millimeter diameter tie bars were assembled in sections for each span, again using the swinging stage.

Before demolition could commence, it was necessary to ensure that the curved steel arch supports were packed tightly against the soffit of the arch. This was to reduce the likelihood of impact loading on the tower, and also to prevent uneven loading of the tower and structure.

Demolition of Span 6

Procedure

As partial demolition of such a structure had, to our knowledge, never been attempted before, extreme care had to be taken to ensure that only No. 6 span was demolished.

A procedure was established whereby the trackwork was removed in panels and then the ballast and rubble, with front end loaders, excavators and trucks. Twelve hundred (1200) and 850 series excavators were used in pairs. The excavators were placed above piers 5 and 6.

Care was taken to ensure demolition was symmetrical, so that loads induced on the structure would not cause premature collapse.

While rubble infill was removed, parapet walls were also demolished. Stones were removed one at a time, course by course. As the walls were removed, it became increasingly difficult to remove the first stone from each further course, due to the tremendous compressive force in the structure. In most cases, one stone had to be jackhammered by hand, from each course, before the rest could be removed. It was noticed that jackhammering caused vibration of the entire parapet of the structure. A thermal lance was tried to remove the parapet, and thus reduce the vibration. The thermal lance did eliminate vibration, but progress was slow, and several blowbacks occurred, due to bricks being saturated.

Once the parapet walls were demolished and the deck exposed, it was possible to see that the top deck of span 6 had cracked right across the span, and that the parapet had separated from the arch deck.

A concrete saw was used to cut through the top three layers of brick of the seven-layer arch to help relieve the compressive force on the structure. This gave a fault line from which the excavators could operate. The saw was also used to produce vertical cuts on the arch to provide a clean break.

At this stage the 1200 series excavators were used to break out the deck, virtually brick by brick. Excavation was carried out from both sides of span 6 simultaneously. After approximately 10 minutes using a rock breaker, the smaller excavators were brought in to muck out the broken brick. Excavation commenced from the center of the span toward the arches.

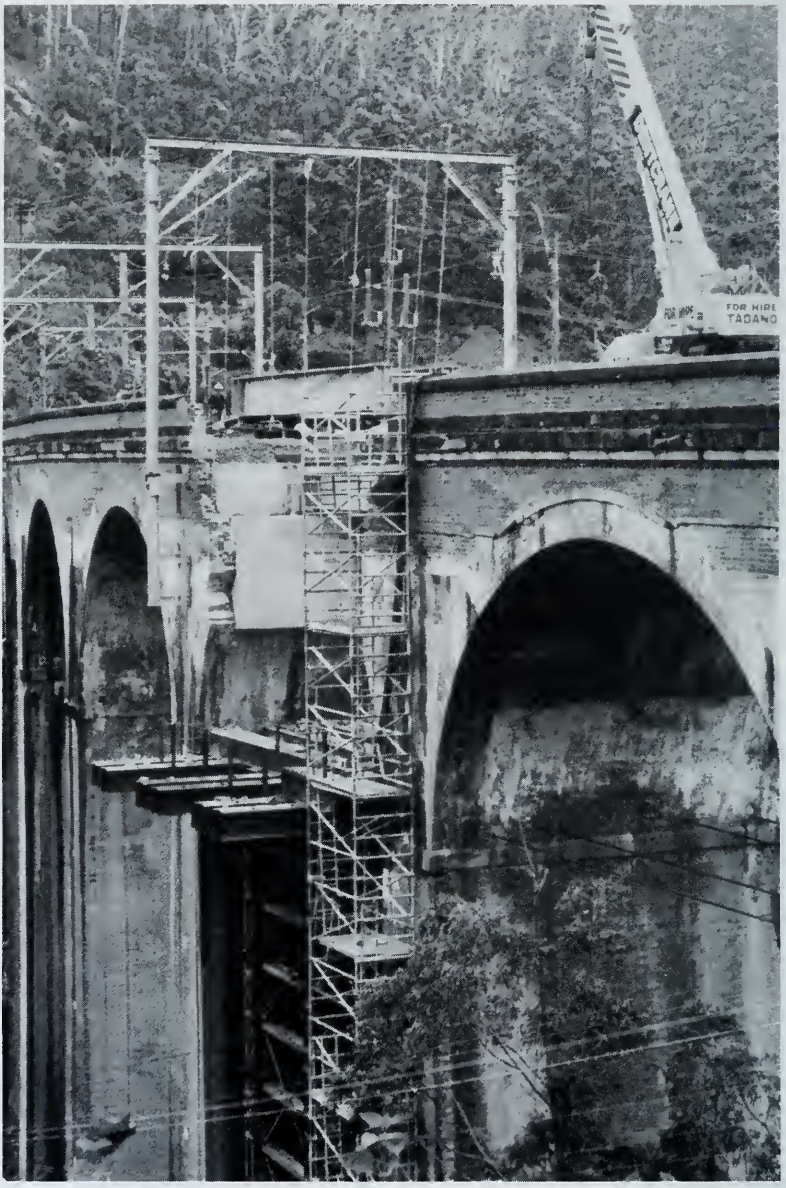
As the large compressive forces in the structure (potentially in the order of 7,000 tons) had clearly caused severe uplift of span 6, the demolition was carried out slowly and uniformly, to give the structure time to relax, rather than have a sudden release of force. The demolition proceeded without any dramatic and explosive release of energy and no substantial shortening of the span.

Reconstruction Works

Procedure

The new structure to span between piers 5 and 6 comprised simply supported steel girders with a concrete ballast trough, supported on reinforced concrete abutment bearing seats located over piers 5 and 6.

After completion of the arch demolition, the ends of the brick arches were trimmed, and a reinforced concrete facing poured. The ballast and arch filling materials were then removed



Working against the clock on a vital Stanwell Park Viaduct in New South Wales.

from above piers 5 and 6 to expose brickwork and sound infill concrete.

Mass concrete pads were then poured over the exposed materials to act as a foundation for the abutment bearing seats. It was necessary to strengthen the existing materials under the foundation pads to support the vertical and horizontal loads to be transferred from the bearing seats. This was achieved by drilling and grouting in galvanized reinforcing bars and rock bolts. Galvanized reinforcement was adopted to give additional corrosion protection in an environment which was known to be porous, and where the complete protection of the bars by grouting could not be relied upon.

Materials

The 14.63 meter long standard depth steel girders were taken from SRA stocks. Normally, one pair of these girders, which is stored with all cross bracing in place, carries one track with a transom deck. For the ballasted deck of the Stanwell Park Viaduct, it was not desirable to introduce a short section of non-ballasted track. The girders were therefore used with concrete topping slabs to retain the ballast. The additional loads due to slab and ballast necessitated the use of three girder pairs to support the two rail tracks.

The reinforced concrete topping slabs were precast in sections and designed to be butted together and bedded on to the steel beams, using epoxy mortar. Longitudinal joints were provided in the deck to keep the weight of the slabs to easily manageable proportions. These joints were concreted after slab installations. The topping slabs were not designed to act compositely with the steel beams for flexure, but to ensure horizontal load transfer, stud connectors were attached to the steel beams, so as to project into the longitudinal joints.

The steel girders were supported on pot bearings obtained at short notice from one of the contracts on the SRA's East Hill Campbelltown Railway project. Free sliding bearings were provided at pier 6, and sliding guided/free sliding bearings provided at pier 5.

Fixity of span against horizontal loads was provided at pier 6 by a steel pin fixed into the bearing seat and connected to the central pair of steel beams.

Expansion Joint

The expansion joint in the ballasted track at pier 5 was designed to provide a compression (i.e. closing) movement capacity of 600 millimeters in maximum increments of 200 millimeters.

After 200 millimeters of closing movement have taken place, it will be necessary to remove the adjacent ballast, cut off the rear 200 millimeters of the upper based plate, and jack the joint apart to restore the 200 millimeter gap.

Other Works

Remedial works were also carried out to spans 7 and 8. Ballast and rubble fill were removed, exposing separation of the up side parapet from the top of the arch. Tie bars were inserted to pull parapets together, and then cracks between parapets and deck were grouted. Vertical supports with blocks were added to brace parapet walls. Chain mesh was placed on spans 7 and 8 to prevent loose bricks from falling and injuring staff below.

Problems Encountered

Monitoring and Investigation

A major difficulty with the project was coordinating of the design and investigation without disrupting the repairs. For design to be undertaken, details like how deformed were the arches needed to be obtained. Unfortunately this required the surveyors using the cranes and riggers buckets (only means of access), and thus preventing further construction work. The competing needs had to be constantly juggled to provide a best fit.

Similarly, constant monitoring of the structure was required in order to determine what was happening and provide early warning of possible major failures during the demolition phase.

Shifting and Overhead Wiring

Due to the long term difficulties that removing the overhead wiring would have caused the electrical branch, it was decided to isolate the power and pull the wires to the side or center, to allow cranes to operate. Unfortunately, this meant numerous shifts of the wiring, so cranes could be working over the parapets and then in the center. Each change of operation usually required a shift in the wiring position.

Signals and Communications Cables

As part of the Illawarra electrification, the

Working against the clock on a vital Stanwell Park Viaduct in New South Wales.

signaling system had been upgraded. Unfortunately, the main cable was fastened to the up parapet of the viaduct. Part of this parapet (span 6) was now to be demolished.

Cable was suspended from overhead wire structures and encased in half round A.C. pipes. Extreme care then had to be taken not to damage the cable during demolition and reconstruction process, as this cable supplied all the signaling to the computerized traffic control building at Wollongong. To further complicate the issue, the existing signal and communication telegraph pole route was located on up side of structure, and the system was still in use.

The main signal cable troughing had to be lowered at each end of the viaduct on the up side to allow access to the abutments.

Site Establishment

Establishing site offices and telephones on a site with limited access was difficult. Available room was restricted due to mountainous terrain and the location of tunnels at each end of the viaduct.

Information Update

Keeping senior members of SRA informed on a need-to-know basis while at the same time keeping the larger number of visitors and sightseers at arms length. Wild speculative rumors also had to be countered.

Security

Security of such a large site to prevent theft, vandalism and injury to sightseers.

Supply of Materials

Arranging for materials and items to be manufactured on extremely short notice. In some cases this meant contacting directors of firms on Christmas Eve, while they are on holidays—interstate, and convincing them they should open their factories—Boxing Day—in order to supply material on January 2nd.

Staff Rostering

Arranging staff and rostering, so that hours did not become excessive. Most staff had already arranged to go on leave, and it became a negotiation exercise to arrange enough staff to cover all aspects of the job. As the work was continuing on a 24 hour basis, three shifts a day, this became quite difficult.

Storage

Storage and delivery of items to site. Access and storage was very limited. Material had to be stored at neighboring stations and brought in as required.

Access

The tunnel south side of the viaduct was ballasted to allow four-wheel drive vehicles or lorries to drive through the tunnel. Large items of plant had to be escorted through the tunnel. A multi-lane highway was constructed to the base of pier 6 to allow repairs. Rope stairs were constructed for access from top to bottom of viaduct.

Legislative Requirements

The access road was not on SRA land so property section and landholders needed to be contacted. Activity was near a water course and required permission for removal of trees from local council. Water Resources Commission and State Pollution Control Commission needed to be advised. Department of Industrial Relations had a significant presence due to requirements for inspection and permits. Soils Conservation Service was also involved.

Time Constraints

Tight time constraints meant that different techniques could not be trailed to test their usefulness before implementation.

Site Safety

Staff was working long hours, in extreme weather conditions, in a hostile environment with constant pressure to get things done quickly. Care had to be taken to ensure procedures were safe and that staff did not become complacent or careless.

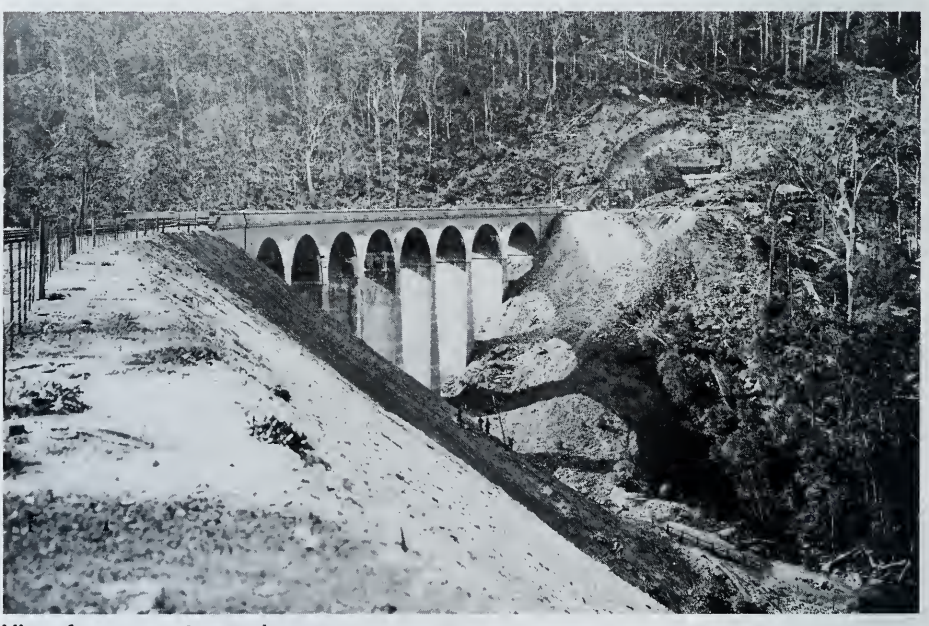
Site Harmony

The long hours and constant pressure meant that tempers became easily frayed. Oil had to be poured on troubled waters on numerous occasions.

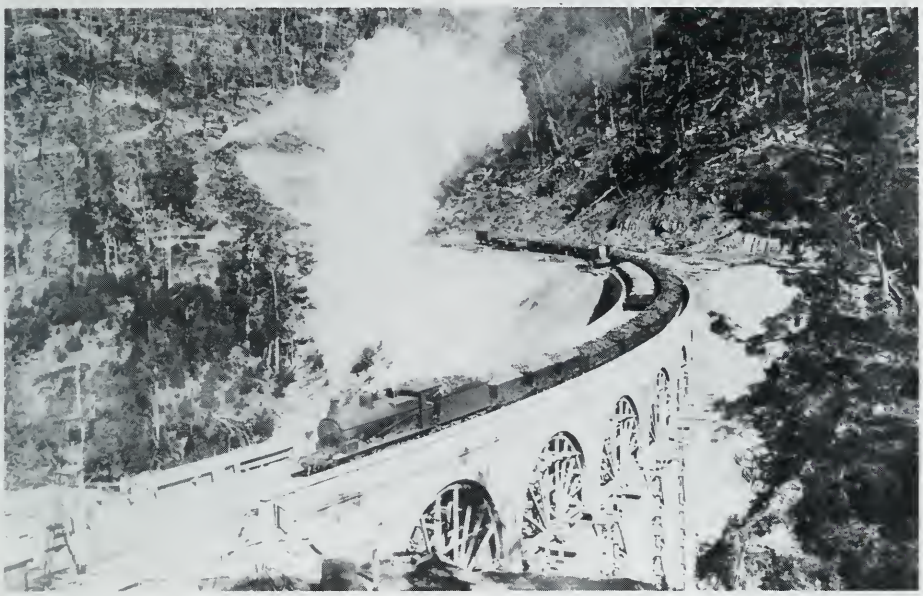
Future Prognosis

Since opening on April 2, 1989, the viaduct has undergone further movement. There has been closure of the structure by 29 millimeters, but ground movement has only been eight millimeters. It would appear that the structure is now undergoing stress relief as a result of removing span 6. There is concern that this stress relief needs to be controlled before the

Protection of the environment.



View from country end.



First ballast train.

First passenger train.

The graceful Stanwell Park (N.S.W.) viaduct in happier days. A NSW GR "standard goods" engine heads towards Sydney with a load of coal — 1958.

structure deforms to such an extent that it becomes unstable. Forecasted additional ground movements in the order of 130 millimeters over the next five to ten years could apply a further compression to the viaduct.

At present, the structure is being constantly monitored and various options to strengthen and/or replace the structure are being investigated.

Acknowledgement

Like the original structure, the work completed between December 13, 1985, and April 2, 1986, is a monument to the SRA staff, consultants, and numerous contractors who were involved. It was a difficult job, well done, in extreme circumstances. A special thanks goes to the families who thought, ate, and slept Stanwell Park Viaduct during these hectic days.

Conclusion

The viaduct was reopened to traffic February 4, 1986. The structure is being continually monitored for further movement.

On behalf of the Associations, I extend our gratitude to SRA and Mr. Hickey for making this video available. Thank you. (Applause)

Mr. Koff: Thank you, Jim. At this time I have two gentlemen here who will give us a presentation on the overview of Canada's GO Transit. Today, in attendance are Mr. Jim Brown, executive director of operations for GO Transit. He has a pretty extensive background in railroad engineering and railroading in general. He joined a Canadian railroad in 1962 as a junior assistant mechanical engineer and progressed through various equipment, transportation, and customer research assignments in Montreal, Ottawa, Edmonton, and principally, Ontario through 1972. In 1972 he joined the Ontario Ministry of Tranportation and Communications as a rail operations engineer responsible for the technical aspects of GO Transit system and which was then a branch of the Ministry. In 1974, with the formation of the GO Toronto area transit authority he became manager rail division of GO Transit and is currently responsible for GO Transit's rail and bus operations, equipment procurement, and maintenance and ticket sales verification.

Also with Mr. Brown is Rick Ducharme. Rick is also with GO Transit as director of engineering development. He is a civil engineer and a graduate of the University of Waterloo in 1972 and has worked for the Ministry of Transportation for four years in various areas such as construction, research, transportation, and transit planning. He joined GO Transit in 1976 as a transit coordinator. Since then he has had various positions in marketing, research, development, engineering, rail operations, and he was director of engineering development before being promoted to executive director. Will you please join me in welcoming these two gentlemen.

GO TRANSIT

James A. Brown

Executive Director Operations

and

R. DuCharme

Executive Director

Mr. Ducharme: Thank you very much. On behalf of Jim and myself, I'd like to welcome everybody to Toronto. I hope that over the last three days you have taken the opportunity to see some of our system. I have a few slides to show, and if you haven't already seen some of our system, try to take a walk over to Union Station and see maybe some of the problems we have, some of the issues we're going to be facing over the next few years.

GO stands for Government of Ontario, and GO Transit was initiated in 1967. It was a single rail line operating between the community of Pickering in the east, through Union Station to the community of Oakville in the west, with two trains coming out of Hamilton as well. This is what we define as our only full service line where it operates all day, both peak and off peak and bi-directional. As you can see, we've expanded our system quite significantly since 1967. These other rail lines are what we call limited service lines and operate between one and up to five trains peak direction only. At the end of the presentation I'll be touching on where we're going from there regarding these lines as well.

In the early 1980s the government started doing fairly major reviews in the Toronto area. There were major traffic problems which have continued to develop since then. GO Transit itself is experiencing some fairly significant ridership increases on those rail lines, and we knew we had to look at expansions that would accommodate three times the ridership that we were then experiencing. As well, there was development going on in downtown Toronto so most of the ridership would be destined to Union Station as exists today. As a matter of interest, we carry 86,000 people a day; 95 percent of the people exit at Union Station. A third of these go to TTC subway and the rest of them are walking to their final destination.

When they started looking at the conventional rail lines in 1982 the government was concerned whether or not we could handle this ridership increase as projected on conventional rail. So some of you may have heard of our getting into a program of what we called GO ALRT, ALRT standing for Advanced Light Rail Transit. The concept was to look at the metro area and set up two major systems, one along the existing Lake Shore Line and one from north metro utilizing different type of equipment. It would be on its own dedicated right-of-way, two tracks, and we were hoping to handle the volume in those corridors. Basically, what happened is that in 1984 they got quite serious about it and construction was started on a piece of the system between Pickering east of Toronto heading into Oshawa. Selectively, they were looking at the corridor between Pickering and Whitby which is about nine and a half miles long.

In parallel with that we were looking at the fact that we had to find alignments that would get everybody down to Union Station. In this diagram the white area in the center represents the train shed roof for Union Station. We looked at various alternatives—elevated alignments, the use of hydro rights-of-way. The big problem was although we were proceeding with an alignment over the east which was fairly easy to build because it was adjacent to an existing expressway, we were running into problems in the center core. The only alignment available was the existing conventional rail right-of-way, and the main problem was not only did we have to operate a GO ALRT system we had to worry about the existing GO rail system, the CN and CP freight system, and the VIA system itself. So we started running into problems and in 1985 the government took a second look at it and

decided to revert to conventional rail technology and announced a fairly significant program for GO Transit, called the GO Train Service Expansion Program. It included an expenditure of about $350 million on four specific projects.

The first one was to continue with the construction at Pickering easterly to Whitby, with a price tag of about $110 million, to look at the three train service out to Milton, expanding that to five trains, and also protecting for the full train service option which is all day service. Also, we were looking at extending to the west from Oakville to Burlington, the full service scenario as far as Burlington. This is our maintenance facility just west of here at Willowbrook and we were looking at expanding this facility to accommodate the 63 bi-levels and the eight locomotives we had on order.

So going back to the specific project out in the east, Pickering to Whitby, in June, 1984, construction had begun on the right-of-way, the feasibility had been done. We had to go through an environmental process in this province which is fairly extensive. The construction continued, this shot will just give you some idea of the proximity between Highway 401 and the railway which is in the center of the diagram. That's the CN Kingston subdivision, and our tracks are in the middle of the two. I talked of the $110 million as the expenditure. Now, not all of it was really GO Transit related. We looked upon this project as a transportation project, and there was a lot of construction adjacent to the highway's interchange. Designs were changed, and we did build a lot of structures as you'll see in the slides that I'll be showing. This is one of those in Liverpool.

When we started the construction in 1984 there was an open field with two farms. By 1986, there was major development and that whole area is filled in now. So the GO Train extension tied in with the interchange has a dramatic effect on that whole community.

We looked at the standards. Basically what we came forward with was 115 pound continuous welded rail. It is my understanding this rail was the last one to be welded at the Belleville facilities east of here. We again did an assessment of the type of ties, wood ties versus concrete ties, and selected the concrete tie which is very similar to the CN's 60B specification. Again we did an assessment on the ballast. We looked at trapp rock, there was a facility and the trapp rock is available around Havelock, versus nickel slag, and we opted out for the nickel slag.

This is the signal system at Pickering, where basically we cut off from the existing CN subdivision onto our exclusive tracks. We had to tie in with the signal system. CN did all that work in our behalf, tied it into their central dispatch downtown.

This is one of the structures in the area of Whitby. This is one of the shots that I showed you previously of the housing increases in that area. That whole interchange, tied in with our stations, cost in the order of $18 million. The station itself was only $2 or $3 million of that, so it gives you some idea of the facets of the transportation element versus just GO rail.

This is another structure in Ajax. This is a close up of the retaining wall. We were tied in fairly closely to the road system in the CN subdivision. We ran into a lot of soil problems here. We couldn't have rock anchors so we were looking at soils anchors. They ran into fairly major problems and there was about a four-month delay on that project.

This is the area where we go under the York subdivision which is a major freight bypass for CN. It was an interesting project in that CN gave us a window of 36 hours. Basically what we did was to bring in the bridge in pieces, put it together adjacent to a temporary trestle that was there, and on Boxing Day, 1987, allowing for a 36 hour window, we slid it into place on rollers and accomplished the feat in 28 hours, due to the good weather and the full cooperation of CN.

This is further work at Pickering and then we got into the station work itself. This is a structure that we put over both Church Street and the Dufferin Creek area. It is a fairly major structure parallel to the existing CN.

This is really just a small project. It's what we call Lynde Creek Culvert. There are about three or four culverts on this section. As I mentioned, we were looking at the Advanced Light Rail Transit project and when there was a decision to reverse it, some of the projects had to be redone. This is one bridge where we had to take off the deck and strengthen. But overall I think the expenditures were only $800,000 to upgrade those section requiring upgrading.

This is Henry Street in Whitby and the final

station in Whitby. Now the service started December 1988, and this is the day of inauguration. We were a little surprised. We built parking lots at Whitby for over 1,000 cars, the one at Ajax holds over 700 cars, and we had complaints on the second day that they were all over parked.

The second project I mentioned is Milton. I'll just quickly go over it. In 1981 we implemented a three-train service to Milton. We have expanded this as of January, 1989, to five trains, and we have intentions to go to full service over the next five years. What we looked at was about three tracks of additional main line to be built, the widening of one of the structures, and signal and track work in the Milton station itself. We have overnight layover of our trains out in Guelph Junction west of Toronto. Now we have expanded from three to five trains. Finally, to accommodate the growth of all this equipment into our fleet and the maintenance of it, we undertook the study of Willowbrook, looking at expanding to the south to accommodate the trains as well as the additional movements through the facility.

I have mentioned the Environmental Assessment Act. They were fairly close in watching this facility because of the type of elements involved. One of the things that fell out of it is we were forced to build a sound barrier on the north side of Willowbrook because of the residential units just north of there. Also, we looked at the expansion, not only of the parking of the extra consists, but we've expanded the wayside power requirements down there, including a redesign for the new locomotives we're bringing in at this point.

We did work within the facility itself. The plant maintenance storage area as well as the diesel shop repair area was almost doubled in size. We expanded the fueling area and are now working on the coach shop area and again, it's expanded by about one third. We are looking at facilities such as wheel truing shops either to put in Willowbrook or at future yards that we are now reviewing.

Burlington is the project now under construction. It will cost on the order of $90 million. There are four contracts just let and work is underway. We expect it to be completed by 1992. That includes an additional main line between Oakville and Burlington which is about 10 miles. What we did in the interim is build a new station. Now, our stations as compared to the old stations built in the 1960s and 1970s, are quite different. They're more conducive to the major volume of people we are now carrying. As well, we did track work and platform work in the area around Burlington. That was about $340 million worth of work.

What we are looking at now, although the Lake Shore is our only full service line with all day service, are expanding the Milton, Georgetown, the Bradford, Richmond and Stouffville lines. We know it means at least one more additional main line, additional signal work. The government has committed as of a month ago, another $400 million to be spent in the next five years over and above the normal projects, so they are really standing behind us, and they see the need to continue to expand. We're really running into ridership increases that are almost impossible to accommodate. When we look at our June figures over last year, our rail ridership is up 19 percent, which surpasses by far what we expected.

Also, we're now serving elements such as the Dome Stadium. You may recognize this photo. It's from the front page of Progressive Railroading. We've been successful in serving the Dome, and, as an out-peak type service, it's something we like to see.

The elements we're facing even more dramatically in early 1990s include the major congestion. This is the Don Valley Parkway. You can see one of our buses trying to meander through the traffic. The car and the bus are not really options if you are going downtown. If you can see the train on its own right-of-way, it's basically the option we are looking at. This Richmond Line will have to be expanded if we're going to accommodate the growth they keep predicting.

Construction, as I say, is already underway at Burlington and we're hoping to see the same type of thing in the next couple of years. We have set up project offices at both CP Rail and CN Rail whereby we will be providing people, along with our own, to come up with all the required preliminary design and functional plans over the next two years to protect all our rights-of-way, to go through environmental planning process, and get on with construction.

At a couple of your sessions you touched on electrification. In the early 1980s, GO was look

ing at that. We see electrification coming back. Every time a structure is built, whether on our right-of-way or within our area, we work through the provincial government because they're always built with the proper clearances for 25 KD electrification.

Once again, I hope you enjoy your stay in Toronto and if you haven't seen some of our system, please take a walk over to Union Station. Thank you. (Applause)

Mr. Koff: If you have any questions, both Mr. Brown and Mr. DuCharme will be glad to answer them for you. I thank you gentlemen for coming here today and sharing that with us. It's nice to see some growth in the rail industry, and I think transit is certainly one area where growth is ongoing, both in Canada and the United States.

Our next feature is a spring frog turnout. Mr. Shaw of Amtrak could not be with us today but we have his video and a little background. Hundreds of miles of concrete ties have been installed in the upgrading of Amtrak's Northeast Corridor. However, between Wilmington, Delaware, and Washington, D.C., there are a number of wayside turnouts for local freight service that are constructed on wood ties resulting in poor ride quality and increased track maintenance. Amtrak has embarked on a program to replace these turnouts with new concrete turnouts using a heavy duty swing nose frog, and the maximum speed over these turnouts is 125 miles an hour. So I think we'll find this video kind of interesting.

Spring Frog Turnout on Concrete Ties

Courtesy of A. E. Shaw, Jr.

Director Engineering Track and Structures
Amtrak

(Whereupon there was a video presentation)

President Matte: Although he's not here we do thank Mr. Shaw for his report. I will now call on Barry Mohl to present the Resolution Committee's report. Barry.

RESOLUTION COMMITTEE REPORT

Having reached the closing of the annual joint conference of the Roadmasters and Maintenance of Way Association of America and the American Railway Bridge and Building Association and being deeply indebted to all those members and friends who have contributed their time and efforts to make our conference a success, it is right that we should acknowledge this indebtedness, and that it shall be so entered into the minutes of this meeting.

Be it further resolved, that our deep appreciation be extended to those who have honored our associations with their presence and by their informative addresses:

R. J. Ritchie, Senior Vice President, CP Rail
E. B. Burwell, Executive Vice President, Norfolk Southern Corporation
W. L. Krestinski, Chief of Unit Engineering, CP Rail
P. R. Richards, Chief Engineer, CN Rail
J. R. Clark, President, American Railway Engineering Association
D. A. Himes, President, Railway Engineering Maintenance Suppliers Association
M. L. Travis, Illinois Department of Transportation
R. C. Kuhn, Union Pacific Railroad

R. J. Blinco, Queensland Railway
D. S. Ball, Union Station Redevelopment Corporation
G. Ebling, Southern Group
W. L. Stephens, GOEX Incorporated
A. E. Shaw, Jr., Amtrak
J. A. Brown, GO Transit
R. Ducharme, GO Transit

and to all the committee chairmen and sponsors, who with the loyal cooperation of the committee members prepared the interesting and instructive reports that have been presented.

Be it further resolved that a very special thanks is expressed to Don Himes, President of REMSA, and to all members of the Railway Engineering Maintenance Suppliers Association for the fine reception that we enjoyed last night. Our thanks are also expressed to Mrs. Patricia Matte and Mrs. Mary Jane Tallent and their committee for their efforts in arranging registration and entertainment for our wives. Our thanks also to the management and staff of the Metro Toronto Convention Centre. A special thanks goes to Pat Weissmann and Barbara Marlow. Without their unselfish assistance, these two Associations would have great difficulty functioning.

And be it finally resolved that both Associations express their heartfelt thanks to the outgoing presidents, Al Matte and Ray Tallent, who have spent so much time and effort in guiding the activities of our two Associations with great efficiency and dedication during the past year.

I move these resolutions be adopted.

Respectfully submitted,
B. C. Mohl, Chairman
Resolutions Committee

President Matte: Thank you, Barry. At this time I would like to take the opportunity to present some of the plaques to our outgoing directors, and I would like to call on Hugh Fuller to come to the podium please. The plaque reads, "Appreciation Award presented by Roadmasters and Maintenance of Way Association of America to H. J. Fuller for his services as director, 1983-1989."

Mr. Fuller: Thank you. (Applause)

President Matte: I would like to call Sam Brunner to the podium. This is the appreciation award and it reads the same as Hugh's.

Mr. Brunner: Thank you. (Applause)

President Matte: Mr. S. J. Hill please come up. Mr. Hill was our Treasurer from 1988 through 1989.

Mr. Hill: Thank you. (Applause)

President Matte: I'll now turn the podium over to Ray Tallent.

President Tallent: I'd like to present plaques to three outgoing directors who have done an outstanding job. These plaques are given in recognition of the job they have done. At this time I would like to call on Chuck Thompson, Leroy Davidson and John VanHuis. This plaque reads, "American Railway Bridge and Building Association presented for services as Director 1986-1989". Each plaque has the director's name on it. (Applause)

JOINT INSTALLATION OF OFFICERS

President Matte: At this time I would like the immediate past president of the Roadmasters Association, Mr. Ray Snyder, to install the officers-elect of the Roadmasters Association and Mr. Don Lewis to install the officers-elect of the B&B Association. Ray and Don.

Mr. Snyder: Thank you, Al. The following is a list of officers-elect of the Roadmasters and Maintenance of Way Association of America for the administrative year, 1989-1990. The officers so named please step forward and take a position on my left. For President, A. Keith Pottorff, director maintenance systems, Atchison, Topeka and Santa Fe Railway, Albuquerque, New Mexico; for First Vice President, Jerome D. Cossel, chief engineer design and construction, Conrail, Philadelphia, Pennsylvania; for Second Vice President, Stephen J. Hill, regional engineer, Soo Line, Chicago, Illinois; Treasurer, Hugh J. Fuller, engineer public projects, CSX Transportation, Jacksonville, Florida. For Directors with terms expiring 1993: N. H. Clark, director maintenance planning, Chicago and North Western Transportation Company, Chicago, Illinois; J. K. Young, assistant general manager engineering, Southern Pacific Transportation Company, San Francisco, California; R. F. Poulsen, maintenance engineer work equipment, Union Pacific, Omaha, Nebraska.

Mr. Lewis: At this time I would like the following officers-elect of the American Railway Bridge and Building Association to come forward and take a place on my left in front of the podium: For President, Byron T. Burns, structure engineer, Atchison, Topeka and Santa Fe Railway, Topeka, Kansas; for Senior Vice President, John J. Horney, construction engineer bridges, Union Pacific, Omaha, Nebraska; for Junior Vice Presidents, Mark C. Walbrun, project engineer, Chicago Union Station, Amtrak, Chicago, Illinois, and Paul H. Saletnik, engineer of buildings, Chicago and North Western Transportation Company, Chicago, Illinois. For Directors with terms expiring in 1992: Doug G. DeBerg, engineer rail-field, Atchison, Topeka and Santa Fe Railway, Topeka, Kansas; Don F. Sorgenfrei, associate, Modjeski & Masters, New Orleans, Louisiana; Joseph A. Lileikis, manager structures, Union Pacific, Omaha, Nebraska. I would like to recognize Mr. R. W. Carter, general B&B supervisor, Burlington Northern, Springfield, Missouri, who will fill a vacancy on our board for the next two years.

Mr. Snyder: Election to a position of leadership in any organization is an honor not to be taken lightly. Your fellow members in electing each of you to your respective office, have expressed confidence in you, first, that you are able to discharge your several duties with distinction. Second, that you are willing to do so.

Mr. Lewis: As the officers of our associations, you will represent to the citizens of this country the true meaning of railway bridge and building and roadway maintenance and construction. You will be our collective voice in the industry. Thus, you will be our common bond with railway personnel throughout the United States and the world.

Mr. Snyder: As the officers of our associations you will represent our best interests in any of your activities or projects always reminding yourselves that your attitude must be a part in any undertaking sanctioned by your respective associations. In this you will be adhering strictly to the constitution and by-laws of our associations. As a representative of the Roadmasters and Maintenance of Way Association of America, I install each of you in the office to which you were elected in your association.

Mr. Lewis: As a representative of the American Railway Bridge and Building Association, I install each of you in the office to which you were elected in your association.

Please remain standing so that Mr. Snyder and I may come down and congratulate you and the audience may applaud. (Applause)

President Matte: At this time I would to call on Mr. Donald A. Himes, president of REMSA. Mr. Himes.

Mr. Himes: Thank you, Al. President Pottorff, President Burns, past presidents, members of Roadmasters and B&B associations, ladies and guests, this is a distinct pleasure for me as president of REMSA to congratulate your associations on their selection of new officers and members of your respective boards. As most of you know, it has been

customary at this time each year for REMSA to present the incoming presidents with a gavel symbolic of authority during the upcoming terms of office. Therefore, I would like, at this time, to present this gavel to President Byron Burns, American Railway Bridge and Building Association.

President-Elect Burns: Thank you.

Mr. Himes: Now, on behalf of REMSA I would like to present this gavel to the new president of the Roadmasters and Maintenance of Way Association of America, Keith Pottorff.

President-elect Pottorff: Thank you. (Applause)

Mr. Himes: And now before presenting REMSA service plaques to outgoing presidents, Al Matte and Ray Tallent, I want to thank them and the members of their boards for the excellent cooperation REMSA has received during the past year. So on behalf of our membership, I would like, at this time, to present this plaque to Al Matte. This plaque reads, "Al Matte, President, Roadmasters and Maintenance of Way Association of America, 1988-1989". Al, thank you very much for your help. (Applause)

And to Ray Tallent, a plaque which reads, "Ray Tallent, Jr., President, American Railway Bridge and Building Association, 1988-1989." Thank you, Ray. (Applause)

It's a pleasure to be here and I thank all of you. (Applause)

President Matte: Thank you, Mr. Himes. I now have to admit it's a burden off my back, and it's a pleasure for me to pass this on to someone else, Keith Pottorff. But before I do that, I have a presentation to make. It's the traditional Roadmasters' President's pin with the year 1989-1990 engraved on it. (Applause)

Now I'll turn the podium over to President Tallent.

President Tallent: It's been a very enjoyable year, the quality of people that I've had to work with, Pat and Barbara in the office keeping me straight. I've enjoyed it. Al and I have given the other people something to shoot for. You know we had 2600 people up here, and now their challenge is to have it next year, and they keep asking me if we're going to have a show next year, and I tell them that's the challenge. (Laughter) So I've enjoyed it. It's been a hectic year. My wife isn't here right now, but I want to thank her for putting up with a lot of things that she had to put up with, not only with my changing jobs, moving to another location and maintaining two households, but also all the time I spent with the B&B Association. But it has been very enjoyable. At this time I would like to turn it over to Byron Burns who is the next president for his remarks. (Applause)

President-elect Burns: Thank you, Ray. When I agreed to chair a committee report in 1978 I had no idea that I would be asked in 1983 to serve as a director of the B&B Association. I certainly never thought that I would be accepting the presidency of this Association today. I am deeply honored that my peers have nominated and elected me to this office. An association such as this continues to grow through the support of its members. One essential type of support lies in the efforts of those individuals who contribute to and chair the committee reports. At this conference you have seen the result of this type of support and the excellent special subject committee reports. The chairmen are to be complimented for their time and efforts spent in preparing and presenting the reports. Those individuals who contributed to those reports should also be complimented, for without the input from people throughout the industry the reports would lack the broad base that makes them truly informative and interesting.

If you have not done so, I urge everyone in the audience to look over the topics for next year's presentations and volunteer to contribute your knowledge and experience to one of the committee reports. Better yet, make the commitment to offer to chair one of the committees. I personally guarantee that the experience will be rewarding and will broaden your contacts and knowledge.

I also urge everyone to promote this and other similar associations by finding new members, both within your respective companies and among your business contacts. One of the purposes of associations such as these is to broaden the knowledge of its members. And by bringing in new ideas, experiences, and knowledge through new members everyone learns and benefits.

Now, on behalf of the Association and myself I would like to thank Ray Tallent for his years of service to the Association. Ray, I have enjoyed working with you for the past six years and know that you will be a great help to the

Executive Board through this next year as its immediate past president. In recognition of his services, I would like to present Ray with this plaque which reads, "Presented to R. A. Tallent, Jr., for his service as Vice President 1985-1988 and President 1988-1989." (Applause)

President Tallent: Thank you.

President-elect Burns: I am certain that I, as well as future presidents, will benefit from your leadership of the Association. I would like to congratulate the new board members for their nomination and election. I'm certain that theirs will be a valuable contribution to this Association. I would also like to congratulate past Board members for their diligent hard work which helped to make this conference such a success. I would like to thank the members of REMSA for their continued support, both in this special show year as well as other years. I would also like to give a very special thanks to Pat Weissmann and Barbara Marlow. I have often thought of them as the glue that holds this Association together. Without their hard work this conference would not have been such a success. I truly look forward to working with them this next year. Thank you. (Applause)

President-elect Pottorff: Thank you, well besides becoming President of Roadmasters just now I just found out I'm a grandfather again. (Laughter and Applause)

I'm honored and proud to be elected President of this great Association. I pledge along with the members of the Board of Directors to continue our search for the best methods of maintaining tracks for this great railroad industry. I encourage each and every member to continue to support the efforts of this organization in North America. This organization has, for the last 100 years, risen to each challenge and has continually furnished new and innovative ideas for track maintenance. Today we are faced with even a bigger challenge—to furnish better track with less track occupancy and lower costs. I know I can depend on the membership of this organization to help us recognize problem areas which need to be addressed. You show support for the association through your involvement.

I would like to extend our thanks to REMSA for their support and hospitality. They not only play a major role in the development of the material and equipment necessary to maintain our track but they furnish an excellent environment for us to plan our maintenance practice for today and the future. Thank you. (Applause)

Now then, I also have a plaque for our outgoing President. Mr. Matte, I've enjoyed the last eight years, and I would like to present this to you. (Applause)

President Matte: Thank you.

President-elect Burns: Members and guests, if there are no other matters to be brought before this session I declare the 101st annual conference of the Roadmasters and Maintenance of Way Association of America and the 94th annual conference of the American Railway Bridge and Building Association adjourned. (Applause)

BRIDGE AND BUILDING BOARD — *1st Row:* P.A. Weissmann, J.M. Williams, B.T. Burns, R.A. Tallent, J.J. Horney, M.C. Walbrun. *2nd Row:* R.C. Karsten, T.J. Parker, J.A. Van Huis, H.L. Davidson, T.V. Dunn, C.E. Thompson, M.L. Bradley, W.H. Nelson.

Past Officers

	1891–1892	1892–1893	1893–1894	1894–1895
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1st V.-Pres.	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle
2nd V.-Pres.	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford
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4th V.-Pres.	G. W. Hinman	C. T. Fuller	E. D. Hines	Walter G. Berg
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson
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Executive Members	W. R. Damon	G. W. Andrews	Q. McNab	James Stannard
	G. W. Markley	J. M. Staten	A. S. Markley	James H. Travis
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	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane

	1895–1896	1896–1897	1897–1898	1898–1899
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. M. Cummin
1st V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley
2nd V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard
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Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes
	L. J. White	W. M. Noon	C. P. Austin	J. H. Markley
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman

	1899–1900	1900–1901	1901–1902	1902–1903
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering
1st V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard
2nd V.-Pres.	J. M. Staten	B. G. Pickering	A. Shane	A. Shane
3rd V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman
4th V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley

	1903–1904	1904–1905	1905–1906	1906–1907
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley
1st V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid
2nd V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty
3rd V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse
4th V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey
	H. Rettinghouse	W. H. Finley	W. O. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt

	1907–1908	1908–1909	1909–1910	1910–1911
President	R. H. Reid	J. P. Canty	H. Rettinghouse	H. Rettinghouse
1st V.-Pres.	J. P. Canty	H. Rettinghouse	J. S. Lemond	F. E. Schall
2nd V.-Pres.	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd V.-Pres.	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th V.-Pres.	W. O. Eggleston	A. E. Killam	J. N. Penwell	L. D. Hadwen
Secretary	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S. Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Eggleston
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

	1911–1912	1912–1913	1913–1914	1914–1915
President	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st V.-Pres.	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd V.-Pres.	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd V.-Pres.	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th V.-Pres.	T. J. Fullen	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer	J. P. Canty	J. P. Canty	J. P. Canty	F. E. Weise
Executive Members	G. Aldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	F. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915–1916	1916–1917	1917–1918	1918–1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919–1920	1920–1921	1921–1922	1922–1923
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnson	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923–1924	1924–1925	1925–1926	1926–1927
President	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres.	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres.	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres.	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres.	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	P. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927–1928	1928–1929	1929–1930	1930–1934
President	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres.	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres.	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	H. I. Benjamin
3rd V.-Pres.	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Krausch
4th V.-Pres.	A. I. Gauthier	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise		
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

	1934–1935	1935–1936	1936–1937	1937–1938
President	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres.	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres.	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres.	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres.	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCloy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938–1939	1939–1940	1940–1941	1941–1942
President	Armstrong Chinn	A. E. Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres.	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres.	A. E. Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres.	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres.	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.	C. A. Lichty	C. A. Lichty		
Secretary	. . . . .	. . . . .	F. O. Whiteman	A. G. Shaver
Treasurer	. . . . .	. . . . .	F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

	1942–1943	1943–1944	1944–1945	1945–1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Barnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver† Lorene Kindred‡ Elinor V. Heffern	Elinor V. Heffern	Elise LaChance	Elise LaChance
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

† To November 1, 1942 ‡ To February 1, 1943

	1946–1947	1947–1948	1948–1949	1949–1950
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	W. F. Martens
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	W. A. Huckstep
2nd V.-Pres.	E. H. Barnhart	W. F. Martens	W. A. Huckstep	Guy E. Martin
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	F. R. Spofford
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	Lee Mayfield
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	C. R. Knowles	C. R. Knowles	L. C. Winkelhaus	L. C. Winkelhaus
Directors	Guy E. Martin	H. M. Harlow	Lee Mayfield	H. M. Harlow
	B. R. Meyers	H. B. Christianson	F. M. Misch	V. E. Engman
	L. E. Peyser	F. R. Spofford	W. D. Gibson	G. W. Benson
	H. M. Harlow	Lee Mayfield	H. M. Harlow	F. M. Misch
	H. B. Christianson	Franz M. Misch	V. E. Engman	L. R. Morgan
	F. R. Spofford	W. D. Gibson	G. W. Benson	J. A. Jorlett

	1950–1951	1951–1952	1952–1953	1953–1954
President	W. A. Huckstep	Guy E. Martin	F. R. Spofford	Lee Mayfield
1st V.-Pres.	Guy E. Martin	F. R. Spofford	Lee Mayfield	H. M. Harlow
2nd V.-Pres.	F. R. Spofford	Lee Mayfield	H. M. Harlow	J. A. Jorlett
3rd V.-Pres.	Lee Mayfield	H. M. Harlow	J. A. Jorlett	R. R. Gunderson
4th V.-Pres.	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	F. M. Misch	M. H. Dick	W. H. Huffman	M. H. Dick
	L. R. Morgan	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells
	J. A. Jorlett	J. F. Warrenfells	B. M. Stephens	G. Switzer
	M. H. Dick	W. H. Huffman	M. H. Dick	B. M. Stephens
	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells	W. H. Bunge
	J. F. Warrenfells	B. M. Stephens	G. Switzer	E. R. Schlaf

	1954–1955	1955–1956	1956–1957	1957–1958
President	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
1st V.-Pres.	J. A. Jorlett	R. R. Gunderson	W. H. Huffman	M. H. Dick
2nd V.-Pres.	R. R. Gunderson	W. H. Huffman	M. H. Dick	B. M. Stephens
3rd V.-Pres.	W. H. Huffman	M. H. Dick	B. M. Stephens	H. D. Curie
4th V.-Pres.	M. H. Dick	B. M. Stephens	H. D. Curie	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	B. M. Stephens	J. F. Warrenfells	W. H. Bunge	G. W. Benson
	W. H. Bunge	H. D. Curie	E. R. Schlaf	J. M. Lowry
	E. R. Schlaf	J. M. Lowry	G. W. Benson	H. H. Matthews
	J. F. Warrenfells	W. H. Bunge	J. M. Lowry	T. M. VonSprecken
	H. D. Curie	E. R. Schlaf	T. M. VonSprecken	W. H. Bunge
	J. M. Lowry	G. W. Benson	H. A. Matthews	E. R. Schlaf

	1958–1959	1959–1960	1960–1961	1961–1962
President	M. H. Dick	B. M. Stephens	H. D. Curie	G. W. Benson
1st V.-Pres.	B. M. Stephens	H. D. Curie	G. W. Benson	J. M. Lowry
2nd V.-Pres.	H. D. Curie	G. W. Benson	J. M. Lowry	E. R. Schlaf
3rd V.-Pres.	G. W. Benson	J. M. Lowry	E. R. Schlaf	H. A. Matthews
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	J. M. Lowry	W. H. Bunge	H. A. Matthews	R. C. Baker
	R. C. Baker	E. R. Schlaf	M. J. Hubbard	R. H. Miller
	W. H. Bunge	H. A. Matthews	R. C. Baker	Shirley White
	E. R. Schlaf	M. J. Hubbard	R. H. Miller	H. M. Wilson
	H. A. Matthews	R. C. Baker	Shirley White	R. D. Hellweg
	M. J. Hubbard	R. H. Miller	H. M. Wilson	F. W. Hutcheson

	1962–1963	1963–1964	1964–1965	1965–1966
President	J. M. Lowry	E. R. Schlaf	R. C. Baker	H. M. Wilson
1st V.-Pres.	E. R. Schlaf	R. C. Baker	H. M. Wilson	R. D. Hellweg
2nd V.-Pres.	H. A. Matthews	Shirley White	R. D. Hellweg	J. W. DeValle
3rd V.-Pres.	R. C. Baker	H. M. Wilson	J. W. DeValle	W. F. Armstrong
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	E. F. Snyder	E. F. Snyder	E. F. Snyder
Directors	Shirley White	R. D. Hellweg	W. F. Armstrong	J. A. Goforth
	H. M. Wilson	F. W. Hutcheson	J. S. Ellis	E. R. Simmons
	R. D. Hellweg	W. F. Armstrong	J. A. Goforth	N. D. Bryant
	F. W. Hutcheson	J. W. DeValle	E. R. Simmons	A. R. Dahlberg
	W. F. Armstrong	J. A. Goforth	N. D. Bryant	J. S. Ellis
	J. W. DeValle	E. R. Simmons	A. R. Dahlberg	T. L. Fuller

	1966–1967	1967–1968	1968–1969	1969–1970
President	R. D. Hellweg	J. W. DeValle	W. F. Armstrong	J. A. Goforth
1st V.-Pres.	J. W. DeValle	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg
2nd V.-Pres.	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg	T. L. Fuller
3rd V.-Pres.	J. A. Goforth	A. R. Dahlberg	T. L. Fuller	N. D. Bryant
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	N. D. Bryant	J. S. Ellis	N. F. Lucas	W. H. Rankin
	A. R. Dahlberg	T. L. Fuller	W. L. Short	E. E. Runde
	H. F. Lucas	R. A. Youngblood	C. E. Wachter	T. A. Reynolds
	J. S. Ellis	H. F. Lucas	A. C. Jones	J. J. Ridgeway
	T. L. Fuller	W. L. Short	W. H. Rankin	J. R. Williams
	R. A. Youngblood	C. E. Wachter	E. E. Runde	J. W. Chambers
	V. D. Raessler	A. C. Jones	T. A. Reynolds	R. E. Frame
	W. L. Short	W. H. Rankin	J. J. Ridgeway	J. C. Hobbs
	C. E. Wachter	E. E. Runde	J. R. Williams	

	1970–1971	1971–1972	1972–1973	1973–1974
President	A. R. Dahlberg	T. L. Fuller	N. D. Bryant	E. E. Runde
1st V.-Pres.	T. L. Fuller	N. D. Bryant	E. E. Runde	J. J. Ridgeway
2nd V.-Pres.	N. D. Bryant	E. E. Runde	J. J. Ridgeway	J. R. Williams
3rd V.-Pres.	E. E. Runde	J. J. Ridgeway	J. R. Williams	W. R. Rankin
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	T. A. Reynolds	J. W. Chambers	R. K. Corbett	D. C. Gould
	J. J. Ridgeway	R. E. Frame	J. R. Iwinski	W. S. Stokely
	J. R. Williams	J. C. Hobbs	J. S. Pritchett	W. C. Sturm
	J. W. Chambers	R. K. Corbett	D. C. Gould	J. W. Davidson
	R. E. Frame	J. R. Iwinski	W. S. Stokely	C. A. Hughes
	J. C. Hobbs	J. S. Pritchett	W. C. Sturm	W. R. Hyma
	R. K. Corbett	D. C. Gould	J. W. Davidson	O. C. Denz
	J. R. Iwinsky	W. S. Stokely	C. A. Hughes	R. C. McMaster
	J. S. Pritchett	W. C. Sturm	W. R. Hyma	W. E. Brakensiek

	1974-1975	1975-1976	1976-1977	1977-1978
President	J. J. Ridgeway	J. R. Williams	W. H. Rankin	J. R. Iwinski
1st V.-Pres.	J. R. Williams	W. H. Rankin	J. R. Iwinski	W. C. Sturm
2nd V.-Pres.	W. H. Rankin	J. C. Hobbs	W. C. Sturm	D. C. Gould
3rd V.-Pres.	J. C. Hobbs	J. R. Iwinski	D. C. Gould	J. W. Chambers
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	J. W. Davidson	W. E. Brakensiek	J. W. Chambers	W. J. Gunkle
	C. A. Hughes	O. C. Denz	M. Noyszewski	W. E. Halley
	W. R. Hyma	R. C. McMaster	W. J. Gunkle	K. L. Wammell
	W. E. Brakensiek	F. R. Lindsay	W. E. Halley	J. Budzileni
	O. C. Denz	M. Noyszewski	K. L. Wammel	B. J. King
	R. C. McMaster	W. C. Sturm	J. Budzileni	J. G. Robertson
	F. B. Lindsay, Jr.	W. J. Gunkle	B. J. King	O. C. Denz
	M. Noyszewski	W. E. Halley	J. G. Robertson	E. C. Patterson
	Jim Payne	K. L. Wammel		W. S. Stokely

	1978-1979	1979-1980	1980-1981	1981-1982
President	W. C. Sturm	D. C. Gould	J. W. Chambers	W. R. Hyma
Sr. V.-Pres.	D. C. Gould	J. W. Chambers	R. C. McMaster	O. C. Denz
Jr. V.-Pres.	J. W. Chambers	R. C. McMaster	W. R. Hyma	J. Budzileni
Jr. V.-Pres.	R. C. McMaster	W. R. Hyma	O. C. Denz	J. M. Williams
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Pat Weissmann
Treasurer	W. F. Armstrong	W. F. Armstrong	W. F. Armstrong	W. C. Sturm
Directors	J. Budzileni	O. C. Denz	J. W. Davidson	D. A. Bessey
	B. J. King	W. J. Gunkle	C. M. Russell	J. N. Michel
	J. G. Robertson	W. S. Stokely	J. M. Williams	P. H. Saletnik
	O. C. Denz	L. D. Green	D. A. Bessey	O. D. Anthony
	E. C. Patterson	C. M. Russell	J. N. Michel	J. T. Kapp
	W. S. Stokely	J. M. Williams	P. H. Saletnik	D. J. Lewis
	L. D. Green	D. A. Bessey	O. D. Anthony	J. W. Davidson
	C. M. Russell	J. N. Michel	J. T. Kapp	H. J. Laga
	J. M. Williams	P. H. Saletnik	D. J. Lewis	A. S. Uppal

	1982-1983	1983-1984	1984-1985	1985-1986
President	O. C. Denz	J. Budzileni	J.M. Williams	D. A. Bessey
Sr. Vice President	J. Budzileni	J.M. Williams	D.A. Bessey	J. T. Kapp
Jr. Vice President	J. M. Williams	D.A. Bessey	J.T. Kapp	D. J. Lewis
Jr. Vice President	D. A. Bessey	J.T. Kapp	D.J. Lewis	R. A. Tallent
Secretary	P. A. Weissmann	P.A. Weissmann	P.A. Weissmann	P. A. Weissmann
Treasurer	P. H. Saletnik	P.H. Saletnik	P.H. Saletnik	J. M. Williams
Directors	O. D. Anthony	J.W. Davidson	T.E. Kuhn	B. T. Burns
	J. T. Kapp	D.J. Lewis	D.R. Ladner	J. J. Horney
	D. J. Lewis	T.E. Kuhn	R.A. Tallent	W. J. Semioli
	J. W. Davidson	D.R. Ladner	B.T. Burns	R. E. Fronczak
	H. J. Laga	R.A. Tallent	J.J. Horney	W. P. Cunningham
	A. S. Uppal	B.T. Burns	W.J. Semioli	J. H. Smith
	T. E. Kuhn	J.J. Horney	D.W. Brookings	E. Bond
	D. R. Ladner	W.J. Semioli	W.P. Cunningham	D. L. Steele
	R. A. Tallent		J.H. Smith	M. C. Walbrun

	1986-1987	1987-1988	1988-1989	1989-1990
President	J. T. Kapp	D. J. Lewis	R. A. Tallent	B. T. Burns
Sr. Vice President	D. J. Lewis	R. A. Tallent	B. T. Burns	J. J. Horney
Jr. Vice President	R. A. Tallent	B. T. Burns	J. J. Horney	M. C. Walbrun
Jr. Vice President	B. T. Burns	J. J. Horney	M. C. Walbrun	P. H. Saletnik
Secretary	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann	P. A. Weissmann
Treasurer	J. M. Williams	J. M. Williams	J. M. Williams	J. M. Williams
Directors	W. H. Nelson	M. C. Walbrun	C. E. Thompson	W. H. Nelson
	J. H. Smith	S. Lipkus	H. L. Davidson	T. J. Parker
	J. J. Horney	D. L. Steele	J. A. VanHuis	R. C. Karsten
	M. C. Walbrun	C. E. Thompson	W. H. Nelson	R. C. Carter
	E. Bond	H. L. Davidson	T. J. Parker	T. V. Dunn
	D. L. Steele	J. A. VanHuis	R. C. Karsten	M. L. Bradley
	C. E. Thompson	W. H. Nelson	S. Lipkus	D. G. DeBerg
	H. L. Davidson	T. J. Parker	T. V. Dunn	D. F. Sorgenfrei
	J. A. VanHuis	R. C. Karsten	M. L. Bradley	J. A. Lileikis

CONSTITUTION

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1.** The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings, water service facilities, and other structures, by investigation, reports and discussions.

Section 2. The association shall neither endorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussion unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1.* The membership of this association shall be divided into four classes, viz: Members, life members, associate members and honorary members.

Section 2.* A member shall be a person in a position above rank of gang foreman in connection with engineering, construction and maintenance for railway bridges, buildings and water service facilities: or in the employ of a public regulatory body, a professor of engineering or architecture, a technical editor, a government or private timber expert, a consulting engineer, or an engineer in his employ, engaged in the engineering, construction and maintenance of railroad-related facilities or an engineer employed by a technical service or research and development organization, an officer or engineer of an engineering or scientific society or association whose aims and objectives are compatible with the aims and objectives of this association. Any person desirous of becoming a member shall make application upon the form prescribed by the executive committee, setting forth his name, age, residence and practical experience. He shall furnish at least three references to whom he is personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the executive committee, a majority vote being necessary in either instance.

Section 3.** To be eligible for a life membership a member must have belonged to the association for at least 15†† years and in general must have retired from active railway service due to age or physical disability. He shall have all the privileges of membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2, of this Article.

Section 4. Associates shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to co-operate with members in the study and development of improved practices in the construction and maintenance of bridges, buildings and water facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2 of this Article.

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*Amended September, 1976.
**Amended September 20, 1948
††Amended March 10, 1958.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the unanimous vote of the members present at a regular meeting. They shall have all the rights of members except that of holding office and shall be exempt from the payment of dues.

Section 6. Any member guilty of conduct unbecoming to a railroad officer and a member of this association, or who shall refuse to comply with the rules of this association, shall forfeit his membership on a two-thirds vote of the executive committee.

Section 7. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 8.** Only members shall hold office in this association, and only members and life members shall be entitled to vote in the election of officers.

ARTICLE IV.

OFFICERS

Section 1‡‡. The officers of the Association shall be a President, two Junior Vice Presidents, a Senior Vice President, a Treasurer and nine Directors, who, with the most recent Past President, shall constitute the Executive Committee.

Section 2. The past presidents of this association, previous to the most recent past president, who continue to be members shall be privileged to attend all meetings of the executive committee, of which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1.** The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association, but shall not have the power to render the association liable for any debt beyond the amount then in the treasury plus accounts receivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND SECRETARY AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unanimous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any member of the

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*Amended October 16, 1941.
†Amended September 21, 1957.
‡Amended September 28, 1966.
‡‡Amended September 20, 1978.
° Amended October 7, 1982.

association not in arrears for dues shall be eligible for office, but the president shall not be eligible for re-election.

Section 2††. The President, two Junior Vice Presidents, and Treasurer shall hold office for one year and the Directors for three years; three Directors being elected each year. The Senior Vice President shall hold office for one year and ascend to the office of President at the expiration of such service. All officers shall retain their office until their successors are elected and installed. A Director elected for a three-year term shall not be eligible to serve two consecutive terms.

Section 3.° The term of office of the treasurer may be terminated at any time by two-thirds vote of Executive Committee. The compensation of the treasurer shall be fixed by a majority vote of the Executive Committee.

Section 4.° The secretary shall be appointed by a majority vote of the Executive Committee and the term shall terminate with the appointment of successor. The Executive Committee shall have the power, by two-thirds vote, to remove the secretary and appoint successor at any time. The salary of the secretary shall be decided by a majority vote of the Executive Committee.

Section 5.° The secretary and the treasurer shall be required to give bond in an amount to be fixed by the Executive Committee.

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1†. Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears, may be stricken from the list of members at the discretion of the executive committee.

Section 2.‡ A person stricken from the list of members because of non-payment of dues, upon written application may be reinstated as a member in his former class without loss of privileges, either upon payment of all back dues (which must accompany applications) or at the discretion of the executive committee voting in the manner prescribed in Section 2, Article III.

ARTICLE VIII.*

LOCAL SECTIONS

Section 1.** Upon the application of ten or more members of the association residing in the same geographical district, or having offices therein, the executive committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this association as the section membership may adopt and the executive committee approve.

Section 2. The parent association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

By-Laws

TIME OF MEETING

1.** The regular meeting of this association shall convene annually during the month of September, the exact date to be fixed by the executive committee.

PLACE OF MEETING

2.** The place of holding the annual convention shall be Chicago, Ill.

3. It shall be within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

***DUES

5. The annual dues for the fiscal year ending August 31, and payable in advance, shall be as follows:°

Members, $20.00; Associate Members, $20.00.§

DUTIES OF OFFICERS

6.† The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall with the secretary sign all contracts or other written obligations of the association which have been approved by the executive committee. He shall render a detailed report at least three times during the year to the members of the executive committee, showing the financial condition of the association and its activities.

At the annual meeting the president shall present a report containing a statement of the general conditions of the association.

7.‡‡ The Vice-Presidents in order of seniority shall preside at meetings in the absence of the President and discharge his duties in case of a vacancy in his office. The Senior Vice President shall have the senior position of Vice Presidents.

8.† It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts, between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

9.‡ The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the executive committee. He shall report at each annual meeting on the condition of the finances.

NOMINATING COMMITTEE

10.# After each annual meeting the president shall appoint a committee consisting of five members. Two Past Presidents shall be members of this committee, one of whom shall act as Chairman. No other officers of the Association shall be appointed to this committee. This committee shall prepare a list of names of nominees for officers to be voted on at the next annual convention in accordance with ARTICLE VI of the Constitution, said list to be read at the business session of said convention. Nothing in this section shall be construed to prevent any member making further nominations provided that such nominations are received by the President in writing not less than thirty (30) days in advance of the first day of the annual meeting. Such nominations should be addressed to the President of the Association at its headquarters office.

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‡Adopted October 17, 1940.
#Amended March 23, 1983.
†Amended September 20, 1948.
‡Amended September 21, 1957.
‡‡Amended September 20, 1978.

AUDITING COMMITTEE

11.‡ Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

COMMITTEE ON SUBJECTS FOR DISCUSSION

12. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

13. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

PUBLICATION COMMITTEE

14. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to cooperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

ORDERS OF BUSINESS

15.† Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

16. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise, all discussions shall be governed by Robert's rules of order.

AMENDMENTS

17.† The By-Laws can be amended by a two-thirds vote of those present at any regularly called executive committee meeting.

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†Amended September 20, 1948.
*Article adopted 1922.
**Amended September 20, 1948.
‡Amended September 21, 1957.
***Amended September 15, 1965.
§Amended June 8, 1984

YOUR AD COULD BE INCLUDED IN THIS SECTION!

For more information contact:

American Railway
Bridge & Building Association
18154 Harwood Avenue
Homewood, Illinois 60430
Telephone: 708-799-4650
FAX: 708-799-4703

ACTIVE MEMBERS

Joined

Adams D A, Gen B&B Supv, UP RR, 2333 Walnutwood, Baton Rouge, LA 70816 09-26-84
Allen J P, Engr Strs, NS Corp, 99 Spring St, Atlanta, GA 30303 09-20-87
Anderson B R, Engr Of B&B, Conrail, 600 Corporate Crcl, Harrisburg, PA 17110 10-04-82
Anderson N M, Mgr Br Mtce, UP RR, 121 W 15th, Cheyenne, WY 82001 09-30-88
Anderzunas P P, Asst Div Engr, Conrail, 211 Knotty Oak Dr, Mt Laurel, NJ 08054 05-08-84
Anthony O D, Chf Engr, B&A RR, North Maine Junct Pk,RR 2, Bangor, ME 04401 10-05-71
Armenta C G, Supv Strs, AT&SF RY, 12969 Road 37, Madera, CA 93637 10-07-82

Bagwell M W, Chf Engr, Mississippi Export RR, PO Box 743, Moss Point, MS 39563 03-16-88
Bailey J, Supv B&B Dept, METRA, 14736 S Major, Oak Forest, IL 60452 08-31-77
Baker R C, Mgr Wrk Equip, EJ&E RY, PO Box 899, Gary, IN 46401 09-14-80
Banicki R J, Engr Const & Facil Ops, IC RR, 233 N Michigan Ave, Chicago, IL 60601 04-02-86
Banks E G, Supv Scales, SP Trans Co, 1 Market Plaza Rm 1007, San Francisco, CA 94105 04-29-83
Barber S E, Proj Engr, Conrail, 15 N 32nd St, 10th Flr, Philadelphia, PA 19104 12-17-87
Barrett J E, Sr VP, Alfred Benesch & Co, 233 N Michigan, Chicago, IL 60601 12-09-71
Barrett P L, Engr Const & Mtce, AT&SF RY, 7412 Jefferson St NE, Albuquerque, NM 87109 02-17-82
Barrios R, Strl Engr, Modern Industries, Inc, PO Box 23620, Louisville, KY 40223 01-09-90
Bartholomew D E, Sr Proj Mgr RR Facilities, Sverdrup Corp, 1200--112th Ave NE POB 369, Bellevue, WA 98009 09-15-86
Bateman J D, B&B Supv, UP RR, 8831 Silent Stream, San Antonio, TX 78250 12-03-82
Battle, Jr E A, Sr Engr Shops & Yards, Metro North Commuter RR, 347 Madison Ave, 11th Flr, New York City, NY 10017 09-21-87
Beattie G W, Asst Supt Mtce, AT&SF RY, PO Box 386, La Junta, CO 81050-0386 11-05-82
Beebe L C, Mgr Sfty Srvcs, UP RR, 1416 Dodge St, Rm 800, Omaha, NE 68179 12-04-85
Begnaud R A, Asst Engr/Br Dsgn, Amtrak, 2961 Hale St, Philadelphia, PA 19149 05-08-84
Beirne J M, Mgr Trk Insp, NS Corp, 8 N Jefferson St-Box 52, Roanoke, VA 24042 08-20-76
Benes R F, Resident Engr, Calocerinos & Spina Engrs, 3955 Yale St, Hamburg, NY 14075 04-27-87
Bennett C P, Asst Engr-Grd Sprtn Strs, NS Corp, 99 Spring St SW, Atlanta, GA 30303 01-09-90
Benton, III W, Asst Engr Bridges, NS Corp, 99 Spring St SW, Atlanta, GA 30303 08-17-88
Beran J R, Chf Engr-Design, UP RR, 1416 Dodge St Rm 920, Omaha, NE 68179 09-07-83
Bessey D A, Asst Chf Engr-Strs (Ret), Milwaukee Road, 4455 Oak View Dr, Sarasota, FL 34232 08-31-77
Bhalakia M P, Dsgn & Constr Engr, P&LE RR, Store House A, McKees Rocks, PA 15136 09-16-73
Bibly K C, Mgr Pwr Hse, Amtrak, 210 S Canal St, Chicago, IL 60606 10-10-67
Billings J D, B&B Supv, C&NW Trans Co, 375 Beech St, Chadron, NE 69337 10-03-74
Billingsley R E, Gen B&B Supv, NS Corp, 8 N Jefferson St, Roanoke, VA 24042-0049 12-05-86
Binkley W O, Gen Supv Br, CSX Transportation, PO Box 18052, Jacksonville, FL 32229 10-18-79
Birgenheier J A, Sr Insp-Engr Mtls, BN RR, PO Box 29136, Overland Park, KS 66201-9136 02-06-89
Bishop G L, Strl Dtlr, NS Corp, 99 Spring St, Atlanta, GA 30303 09-20-87
Blackier S, B&B Master, CN RY, 1234 Main St, Moncton,NB,Canada,E1C 1H7 06-01-89
Blankenship B, Supv B&B, CSX Transportation, Lynn Avenue, Corbin, KY 40701 03-15-89
Boileau R J, Bridge Engr, BN RR, PO Box 29136, Overland Park, KS 66201-9136 03-27-85
Bonas D J, Asst Engr Strs, NS Corp, 99 Spring St SW, Atlanta, GA 30303 11-02-83
Bond E, Chf Engr Br & Strs, NS Corp, 99 Spring St SW, Atlanta, GA 30303 09-28-66
Boone S H, Supt-Bldg Mtce, SEPTA, 200 W Wyoming Ave, Philadelphia, PA 19140 01-09-90
Boraas R S, Engr Of Strs, D&RGW RR, PO Box 5482, Denver, CO 80217 10-02-86
Borg M T, Gen Supv B&B, BN RR, 20412 Tallman Dr, Parker, CO 80134 02-24-84
Boyd J E, Mgr Rail & Ties, AT&SF RY, 7412 Jefferson St NE, Albuquerque, NM 87109 10-04-82
Bradley M L, Proj Engr, Conrail, 3209 Heatherside Dr, Dublin, OH 43017 08-31-82
Brashares R E, B&B Supv, CSX Transportation, PO Box 414, Montgomery, AL 36101 09-11-69
Brookings D W, Chf Engr, KCS RY, 114 W 11th St, Kansas City, MO 64105 09-26-77
Brooks, Jr. R L, Supv Strs, AT&SF RY, 1401 Jones St, Ft Worth, TX 76102 10-08-80
Broussard C T, AGM-Mtce, L&D RR, 402 W Washington, New Iberia, LA 70560 08-18-87
Bruestle K E, Asst Chf Engr-Dsgn, BN RR, 9401 Indian Creek Pkwy-Rm 1400, Overland Park, KS 66210 09-07-83
Buchanan R S, Railway Engr, Alfred Benesch & Co, 2696 Douglas Ct, Acworth, GA 30101 09-26-84
Buchko D E, Sr Cvl Engr, Envirodyne Engineers Inc, 2101 Evans Rd, Flossmoor, IL 60422 09-17-75
Buckley, III S J, Sr Engr Strs, NS Corp, 99 Spring St SW, Atlanta, GA 30303 03-26-80
Budzileni J, Sr Strl Dsgnr (Ret), ICG RR, 1315 W Elmdale Ave, Chicago, IL 60660 10-16-63
Burns B T, Structure Engr, AT&SF RY, 920 SE Quincy, Topeka, KS 66612 03-03-78
Burrows F G, Consl Engr (Prof Of Engr), CA State U, 427 Bayside Rd, Apt B, Arcata, CA 95521 10-10-73
Busboom G G, Sr Dsgn Tech, ESCA Consultants Inc, PO Box 159, Urbana, IL 61801 03-21-88
Busch K L, Associate, Horner & Shifrin Cnslt Engrs, 5200 Oakland Ave, St Louis, MO 63110 08-31-77
Butler J L, Mgr B&B Mtce, UP RR, 1000 W 4th St, N Little Rock, AR 72114 09-08-86
Byers W G, Structure Engr, AT&SF RY, 7412 Jefferson St NE, Albuquerque, NM 87109 11-10-69

Calhoun J C, B&B Supv, NS Corp, PO Box 14820, Knoxville, TN 37914 09-26-77
Calhoun R L, Proj Engr, Hazelet ³ Erdal, Inc, 547 W Jackson Blvd, Ste 614, Chicago, IL 60606 09-18-88
Carrato J L, Asst VP, Alfred Benesch & Co, 233 N Michigan Ave, Chicago, IL 60601 09-30-88
Carter A B, Engr Of B&B, CSX Transportation, 115 W Anglewood Dr, Brandon, FL 33511 03-31-77
Carter R W, Gen B&B Supv, BN RR, 3253 E Chestnut Expwy, Springfield, MO 65802-2548 03-27-85
Carter, Jr J N, Asst Div Engr, NS Corp, PO Box 3070, Norfolk, VA 23514 10-20-86
Carver D W, Mgr M/W & Strs, Columbus & Greenville RY, PO Box 6000, Columbus, MS 39703-6000 11-03-81
Castrucci A, Asst Div Engr-Strs, Conrail, 31 E Georgia St, Rm 300, Indianapolis, IN 46204 05-04-82
Cerny L T, Exec Dir, AREA, 50 F St NW Ste 7702, Washington, DC 20001 03-26-80
Chambers R J, Mgr Strs, UP RR, 1416 Dodge St Rm 1000, Omaha, NE 68179 09-07-83
Chan W, Prgm Engr, Conrail, 15 N 32nd St, Rm 1107, Philadelphia, PA 19104 08-28-85
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Charrow A M, Asst Supt Mtce, AT&SF RY, 106 N First St, Belen, NM 87002 10-04-82
Chopra S K, Engr Brs & Strs, CP Rail, Union Sta 65 Front St, Rm 366, Toronto,ONT,Canada,M5J 1E8 09-19-88
Clark J W, Engineer, 154 Marshall Bridge Dr, Greenville, SC 29605 03-31-87
Clark J A, Strl Plng Engr, UP RR, 1416 Dodge St, Rm 1000, Omaha, NE 68179 04-21-89
Clark K L, Gen Supv Strs, AT&SF RY, 4515 Kansas Ave, Kansas City, KS 66106 12-12-88
Clark M A, Dtlr-Str, NS Corp, 99 Spring St SW, Atlanta, GA 30303 08-17-88
Clark T H, Gen Supv Str, CSX Transportation, 2715 Ranier St, Florence, SC 29501 06-01-76
Clary A G, Engr Mtce, Natl Acad Of Sc-Trans Rsrch Bd, 407 S Pitt St, Alexandria, VA 22314 06-08-67
Clary D W, Purchasing Supv, NS Corp, 8 N Jefferson St, Box 72, Roanoke, VA 24042 04-26-88
Cochrane G, Supv Strs, Conrail, 379 Akron St, Lockport, NY 14094 02-06-89
Comstock C F, Partner, Modjeski & Masters, PO 2345, Harrisburg, PA 17105 12-03-87
Conlon P C, Mgr Envrn,Facil& Security, AAR, PO Box 11130, Pueblo, CO 81001 09-16-81
Corcoran R, Engr Facilities Mtce, Amtrak, 1575 S Lumber St, Chicago, IL 60607 06-01-89
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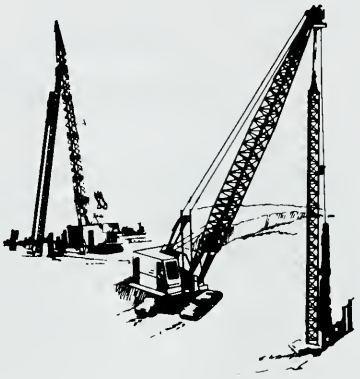

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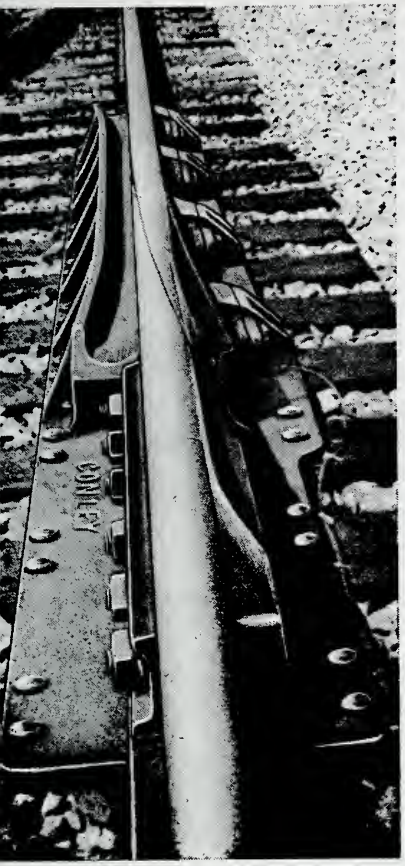

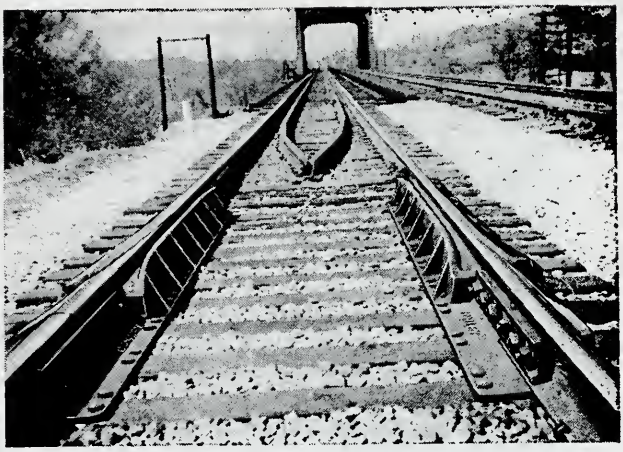

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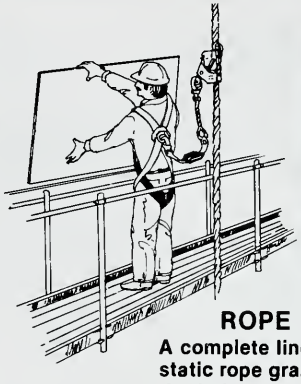

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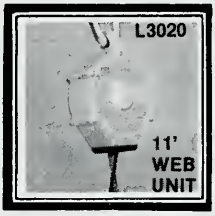

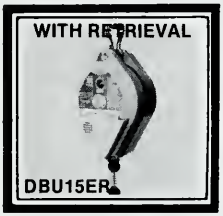

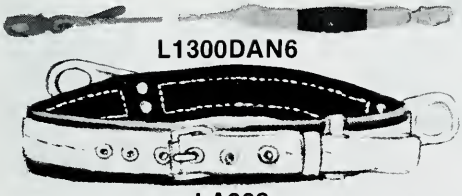

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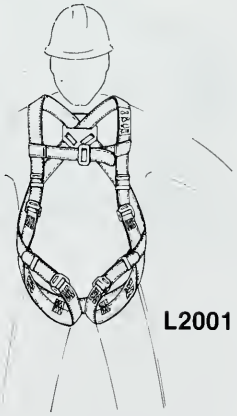

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Anderson H E, Mgr Oprn, Osmose RR Div, PO Box 8276, Madison, WI 53708 02-20-74

Berkel C J, President, Berkel & Co Contractors Inc, PO Box 335, Bonner Springs, KS 66012 09-28-59
Besl M W, VP, Detzel Construction Co, 2160 Langdon Farm Rd, Cincinnati, OH 45222 03-24-76

Callahan J R, Reg Sls Rep, Speno Rail Srvcs Co, 17120 Kenwood, South Holland, IL 60473 02-23-81
Carlson N, Fontaine Truck & Equip, 2007 Fern Valley Dr, Louisville, KY 40213 09-26-84
Christenson T J, VP, Chris Construction Corp, 4622 Femrite Dr, Madison, WI 53716 10-03-74
Christiansen G W, Chairman, Racine Railroad Products, PO Box 4029, Racine, WI 53404 10-09-72
Cliff J, VP Sales, SpanDeck, Inc, PO Box 99, Franklin, TN 37065-0099 08-17-88
Conner C, Div Mgr, Carboline Co, 350 Hanley Industrial Ct, St Louis, MO 63144 08-17-88
Cooney J E, VP, F K Ketler Co, 5000 W 69th St, Bedford Park, IL 60638 10-03-85
Copeland D, Exec Dir, Bridge Grid Flooring Manufacturers Assn, 231 S Church St, Mt Pleasant, PA 15666 08-29-89
Coster P, President, Templeton Kenly & Co, Inc., 2525 Gardner Rd, Broadview, IL 60153 09-20-87

Davis J W, Chf Exec Offr, Kershaw Mfg Co, PO Box 17340, Montgomery, AL 36117 02-17-82
Dolan D E, Asst Area Mgr, Osmose RR Div, 1414 Heather, Kearney, MO 64060 09-26-84
Dresden A S, S.A. Alsan & Assoc Inc, 2300 E Higgins Rd, Ste 305A, Elk Grove Village, IL 60007 08-31-77
Drone W, President, Transportation Products Co, 332 S Michigan Ave, Chicago, IL 60604 09-16-81
Dunn R H, President, R H Dunn & Associates Inc, 10608 Orchard St, Fairfax, VA 22030 09-11-68

Edwards K, Lbr Sls Mgr, McCormick & Baxter Creosoting Co, PO Box 3048, Portland, OR 97208 01-09-90
Emmerich R W, Mgr Of Engrg, Osmose RR Div, PO Box 8276, Madison, WI 53708 10-14-84
Eorgan T D, Sr Sls Engr, Carlisle SynTec Systems, PO Box 7000, Carlisle, PA 17013 03-21-88
Estes C A, Steel Br Frmn, AT&SF RY, 5230 N Broadway, Wichita, KS 67219 04-26-88
Evans R, Agent, Contech Const Prods Inc, 1008 Interloch Ct, Algonquin, IL 60102 08-31-59

Flinn L E, Sls Rep, Western-Cullen-Hayes Inc, 2700 W 36th Place, Chicago, IL 60632 09-14-49
Folk J W, President, Piedmont Railway Supplies Inc, 620 Holcomb Bridge Rd, Roswell, GA 30075 09-12-76
Foraker J W, Reg Mgr-Ind Sls, Burke-Parsons-Bowlby Corp, PO Box 627, Spencer, WV 25276 06-03-83
Foth D D, Exec VP, Natl RR Const & Mtce Assn Inc, 10765 Woodwatch Crcl, Eden Prairie, MN 55402 02-11-86

Gallagher T J, President, Kaufmann-Gallagher Corp, 2647 W 87th St, Evergreen Park, IL 60642 08-17-88
Gallop C M, Manager, Kershaw Mfg--Canada Ltd, 407 Turrene St, Winnipeg,MAN.Canada.R2J 0S5 05-15-74
Gaynor W, President, F K Ketler Co, 5000 W 69th St, Bedford Park, IL 60638 09-17-80
Goray J V, Chf Engr, Graciano Corp, 7925 Hill Ave, Pittsburgh, PA 15221 09-12-76

Hannon T, President, United Right-Of-Way Inc, 314 Larkspur Turn, Peachtree City, GA 30269 09-21-87
Holt D L, President, David L Holt Co Inc, 19715--61st Ave SE, Snohomish, WA 98290 09-17-86
Hunt H W, Dougherty Foundation Prod Inc, P O Box 688, Franklin Lakes, NJ 07417 03-10-72
Hutchinson B, Prod Supv, Wilson Concrete Co, PO Box 7208, Omaha, NE 68107 09-30-88

Kahn S, Market Dvlpmnt, Lubriquip, Inc, 18901 Cranwood Pkwy, Cleveland, OH 44128 08-27-89
Klosk M J, President, Railroad Maintenance Corp, 432 Zerega Ave, Bronx, NY 10473 04-01-85
Koch O, Territory Mgr, Fairmont RY Motors, PO Box 423, Montgomeryville, PA 18936 02-06-89
Kontonis P, Civil Engr, Panos Kontonis Ltd, 18 K Palama St, Paleo Psychiko 154-52,Athens.Greece. 06-14-85
Kontonis Y P, Civil Engr, Panos Kontonis Ltd, 18 K Palama St, Paleo Psychiko 154-52,Athens.Greece. 08-17-88
Kunstel, Jr D W, Sls Engr, Contech Const Prods Inc, PO Box 285, Vienna, MO 65582-0285 10-20-86

Lamb J H, President, SpanDeck, Inc, PO Box 99, Franklin, TN 37065-0099 08-17-88
Lantz R L, Mktg Mgr-West, Koppers Industries, Inc, 188 Industrial Dr, Elmhurst, IL 60126 12-08-75
Ledingham J B, President, Ocean Coatings Ltd, Box 58354 Station L, Vancouver,BC.Canada.V6P 6E4 11-05-75
Leonard H G, President, Swing-Lo Suspended Scaffold Co, PO Box 128, Covert, MI 49043 08-14-86
Lokey, Jr. L N, Area Mgr, Osmose RR Div, PO Box 117, Griffin, GA 30224 03-25-81
Low D, Mgr Subox Div, Carboline Co, 350 Hanley Ind Ct, St Louis, MO 63144 04-01-85
Lynch J K, Sls Mgr, Vulcan Materials Co, PO Box 7497, Birmingham, AL 35253 09-19-51
Lynde J H, Dist Mgr, Fairmont Railway Motors, 10540 Marty Ste 210, Kansas City, MO 66212 09-15-86
Lynn A, President, Quikbridge, PO Box 7069, Berkeley, CA 94707 03-26-86

Mahoney M W, President, Dodge Engineering Co, 8989 N 138th St, Omaha, NE 68142-1224 09-16-81
Mashburn J I, President, Ozark Railway Supplies, Inc, PO Box 10765, Springfield, MO 65808 12-09-77
Maxa R J, Midwest Sls Mgr, Pileco-Delmag Inc, 27150 Pillsbury Ave, Lakeville, MN 55044 08-10-83
McCabe J, GM, Midwest Industrial Products, 3818 N Clark St, Chicago, IL 60613 09-07-83
McCarthy M F, Chf Est/Heavy Hwy, McCarthy Bros Co, 1341 N Rock Hill Rd, St Louis, MO 63124 08-17-88
McComb E, Dist Mgr, Fairmont Railway Motors, Box 196, Champlin, MN 55316 09-26-84
McGuire R F, Area Mgr, Osmose RR Div, 14627 W 89th St, Lenexa, KS 66215 04-29-71
Meyer J J, VP & GM-M/W, Western-Cullen-Hayes Inc, 120 N Third St, Richmond, IN 47374 03-26-80
Milton M A, Hall Cntrcting Corp-Gunite/Shotcrete Div, 122 McNeeley Dr, LaFollette, TN 37766 01-28-88
Moorhead W H, VP Sls & Engr, Iron Horse Engrg Co Inc, PO Box 5398, Suffolk, VA 23435 09-26-84

Neidert M, Reg Mgr RR Sls, Burke-Parsons-Bowlby, 2879 Burwyn Hills, Tecumseh, MI 49286 01-09-90
Nicely C M, President, The R G Smith Co Inc, PO Box 9067, Canton, OH 44711 11-03-80
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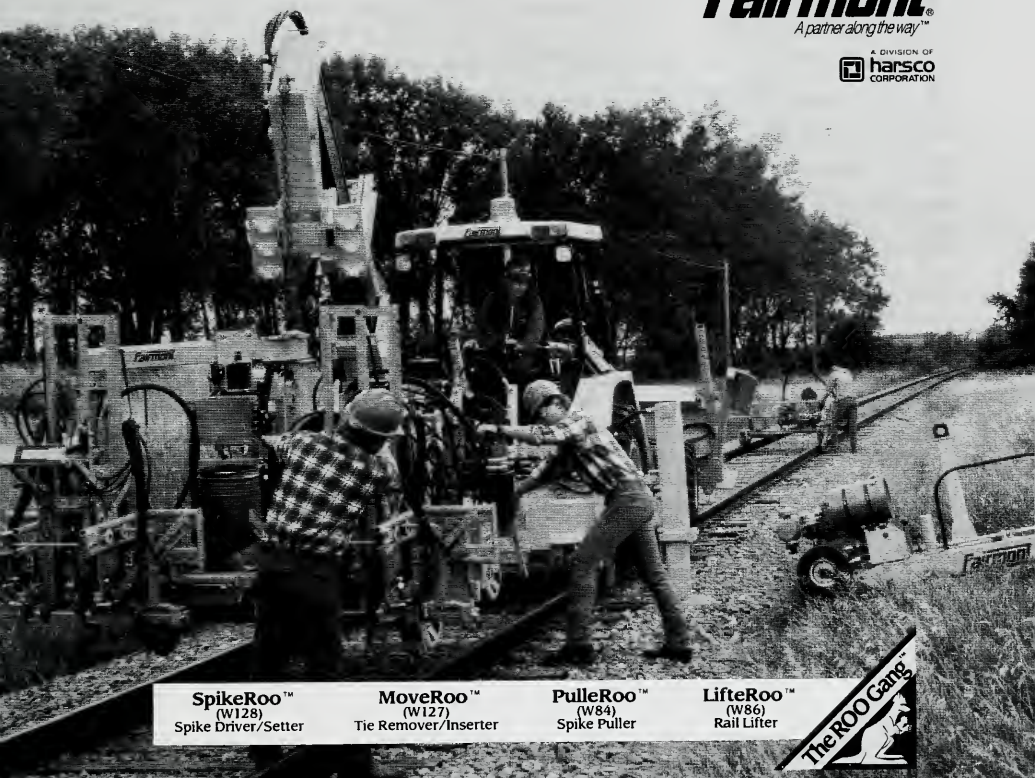

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Posthauer R J, Partner, Evans & Posthauer Engineers, 99 Railroad Station Plaza, Hicksville, NY 11801 02-23-81
Potter R H, President, Reid H Potter Assocs Inc, 103 S Freeport Rd, Freeport, ME 04032 09-28-66
Pratt C O, Pratt Mtls & Tech Cnsltng Srvcs, Rd 5 Box 332, Valencia, PA 16059 04-30-80

Reilly W C, Chrmn Bd-GM, Conley Frog & Switch Co, PO Box 9188, Memphis, TN 38109 04-21-60
Ridenour M, Prod Mgr, Hall Cntrctng Corp-Gunite/Shotcrete Div, 703 S Massachusetts Ave, LaFollette, TN 37766 01-09-90

Schoulties A P, Srvc Engr, Contech Const Prods Inc, 1001 Grove St, Middletown, OH 45044 09-12-75
Scogin V J, President, Standard Materials Inc, 100 W Pennsylvania, Slidell, LA 70460 09-21-87
Scroggs J E, President, Railway Techniques Inc, 3316 Broadway, Kansas City, MO 64111 02-25-58
Sheets R, President, Sheets Masonary Inc, PO Box 629, Elkview, WV 25071 01-05-89
Shugart F, President, Shugart Mfg Inc, PO Box 748, Chester, SC 29706 09-17-85
Shugart L, Chf Engr, Shugart Mfg Inc, PO Box 748, Chester, SC 29706 09-17-85
Sloat J F, Sr VP Mktg & Sls, Holland Co, 1020 Washington Ave, Chicago Heights, IL 60411 12-12-88
Stephens W, Supv, Explsv Srvcs Div, GOEX, Inc, 423 Vaughn Rd W, Cleburne, TX 76031 04-21-89
Storer J W, Consultant, PO Box 8276, Madison, WI 53708 03-06-61
Stout T P, President, Marta Track Constructors Inc, PO Box 1509, Washington, PA 15301 12-08-75

Titus G M, VP Sales, Burke-Parsons-Bowlby, PO Box 231, Ripley, WV 25276 04-26-88
Triplett T, VP, Shugart Mfg Inc, PO Box 748, Chester, SC 29706 09-17-85

Wahl R C, President, Habco Int'L Inc, 930 N Olive, Kansas City, MO 64120 01-28-88
Wood R W, Sls Rep, Vulcan Materials Co, PO Box 7497, Birmingham, AL 35253 10-02-86
Workman M, Plant Mgr, Wilson Concrete Co, PO Box 7208, Omaha, NE 68107 09-30-88
Workman T, Sls Rep, Wilson Concrete Co, PO Box 7208, Omaha, NE 68107 09-30-88

HONORARY MEMBERS

Armstrong W F, Engr Bldgs (Ret), C&NW Trans Co, 5605 Majestic Garden Lks, Bradenton, FL 34203 01-01-47

Denz O C, Supv Bldg Mtce (Ret), CMSP&P RR, 2247 Farnsworth, Northbrook, IL 60062 10-11-67
DeValle J W, Chf Engr Brs (Ret), Southern RY, 629 Brookline Dr, Marietta, GA 30067 08-03-59

Gunderson R R, Asst VP (Ret), Western Maryland RY, 689 W Lk Howard Dr #107, Winter Haven, FL 33880 10-01-47

Huffman W H, Asst VP/Ch Engr (Ret), C&NW Trans Co, 42115 Village 42, Camarillo, CA 93010 01-01-41

Jorlett J A, Str Engr (Ret), Penn Central, 7306 Lighthouse Way, Holiday, FL 34691 10-17-40

Runde E E, Const Engr-Strs (Ret), IC RR, 154 Wisconsin Ave, E Dubuque, IL 61025 12-07-59

Schlaf E R, Supt Fire Prev (Ret), IC RR, 2136 W Howland, Chicago, IL 60620 07-02-47

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Baker F A, Gen Br Insp (Ret), SP Trans Co, 1031 Madrona St, Monmouth, OR 97361 09-18-55
Barr A S, Chf Reg Engr (Ret), Penn Central, PO Box 12967, Pittsburgh, PA 15241-0967 02-10-66
Barsema M, B&B Supv (Ret), C&NW Trans Co, 28W732 Geneva Rd, West Chicago, IL 60185 10-15-58
Bartley C W, B&B Supv (Ret), BN RR, 1706 Pinyon Dr, Laurel, MT 59044 09-04-66
Beaver J F, Chf Engr (Ret), Southern RY, PO Box 1548, Holmes Beach, FL 33509 06-04-68
Bechly D S, Chf Engr Strs (Ret), IC RR, 168 Haywood Knolls Dr, Hendersonvile, NC 28739 06-04-68
Bell D V, Gen Str Supv (Ret), B&O RR, RR 1, Wellston, OH 45692 02-06-57
Benson D D, Envir Engr (Ret), UP RR, 5631 S Park Pl W, Salt Lake City, UT 84121 08-10-72
Bertel D J, Chf Engr Mtce (Ret), MP RR, 3032 Yucca Rd, Willow Park, TX 76086 03-12-68
Boehling, Jr. H A, Gen Supv Str (Ret), C&O RY, 1509 W Laburnum Ave, Richmond, VA 23227 10-13-48
Born J O, Chf Engr (Ret), Maine Central RR, 398 Brook St, Westbrook, ME 04092 10-03-56
Bowman R M, Gen Frmn B&B (Ret), Penn Central, Newry Lane, Hollidaysburg, PA 16648 01-05-54
Brakensiek W E, Asst Chf Engr Strs (Ret), MP RR, 10143 Farrington Dr, St Louis, MO 63137 09-12-62
Brietzke W F, GM (Ret), Pettibone, 811 E Central Rd #422, Arlington Heights*, IL 60005-3213 12-03-56
Bryant N D, Asst Chf Engr/M-S (Ret), BN RR, RR 1 Box 1622, Chandler, TX 75758-9801 04-07-61
Buckmaster W A, Asst Div Engr (Ret), B&O RR, 3265 N Little Horse Dr, Tucson, AZ 85712 09-19-51
Burch E E, Br Engr (Ret), CMSP&P, 14 Eric St, Norwich, NY 13815 03-04-45
Burpee C M, Editor (Ret), Wood Preserving News, 1051 Mountain View St, Hendersonville, NC 28739 01-01-30
Burris H A, Asst Div Engr (Ret), AT&SF RY, 36894 Hayward, Barstow, CA 92311 01-28-72

Camelle E J, B&B Supv (Ret), SP Trans Co, PO Box 3667, Lafayette, LA 70501 01-05-54
Carlisle R W, B&B Supv, NS Corp, PO Box 1215, Fort Wayne, IN 46801 09-15-86
Carlson A W, Chf Engr (Ret), WP RR, 414 Alameda De Las Pulgas, San Mateo, CA 94402 09-18-55
Carter J W, B&B Supv (Ret), Virginian RY, 1910 Maylin, Salem, VA 24153 05-01-47
Cary N M, Proc Engr Trk (Ret), Southern RY, 533 Windgrove Rd, Marietta, GA 30067 03-16-53
Caywood J A, President (Ret), DeLeuw Cather & Co, 24001 Whites Ferry Rd, Dickerson, MD 20842 07-22-59
Chamberlain P L, Asst To Engr Strs (Ret), Erie Lackawanna RR, 26 Kathleen Pl, Morris Plains, NJ 07950 09-22-41
Chambers J W, Br Const Engr (Ret), MP RR, 12200 Eddie & Park Rd, St Louis, MO 63127 06-18-41
Christensen M C, Asst Chf Engr-Strs (Ret), C&NW RY, 401 W Crystal Ave, Lombard, IL 60148 10-07-63
Clark W H, Chf Engr-Const (Ret), AT&SF RY, 1029 Matador Dr, SE, Albuquerque, NM 87123 09-28-59
Cook, Jr. J C, Gen Frmn B&B/W&S (Ret), AT&SF RY, 3510 Gila (Western Hills), Temple, TX 76501 12-05-59
Cummings L, Gen Br Insp (Ret), SP Trans Co, 2444 Holabird Ave, Klamath Falls, OR 97601-1713 08-12-69
Cummins C P, Br Engr (Ret), St Louis Div Of Hwys, 7934 Stanford Ave, University City, MO 63130 10-13-48

Davidson J W, Asst CE Des & Strs (Ret), BN RR, 10734 Glenwood Ave, Overland Park, KS 66211 08-26-57
Diehl C M, Reg Engr Str & Prs (Ret), Chessie System, Rt 1 Box 83, Clearville, PA 15535 08-31-59
Dixon C E, Supv B&B (Ret), Maine Central RR, 620 Odlin Rd, Bangor, ME 04401 09-21-55
Doherty G D, Div Supv B&B (Ret), Soo Line, 2424 McKinley, Perry, IA 50220 05-08-70
Duncan F, Rdm (Ret), Winston-Salem Southbound RR, 1297 E Cannon Ave, Albermarle, NC 28001 09-09-62
Duquaine D J, B&B Supv (Ret), CMSP&P, 2365 Thompson, Kingman, AZ 86401 08-28-68
Durrant H B, Asst Chf Engr (Ret), UP RR, 3616 S 100th St, Omaha, NE 68124 09-06-68

Edwards J W, B&B Supv (Ret), NS Corp, PO Box 1417, Columbus, GA 31902 09-14-66
Eichenlaub C M, Supt (Ret), San Diego & AZ East RY, 9509 Lamar St, Spring Valley, CA 92077-2810 08-23-43
Erskine J A, Strl Eng (Ret), IC RR, 1663 Hunter Ave, Mobile, AL 36604 07-22-59

Fairchild E H, Asst Engr (Ret), UP RR, 1107 Reid Ave, North Platte, NE 69101 06-30-58
Foreman J E, Dir Engrg Srvs (Ret), B&LE RR, 522 Reynolds Rd, Greenville, PA 16125 02-06-57
Forseth C E, Div Engr (Ret), WP RR, 1116 Oakmont Dr #6, Walnut Creek, CA 94595 03-31-50
Frame R E, Chf Engr Offr (Ret), CSX Transportation, Ocean 2100, Apt F-1, Jacksonville, FL 32250 06-22-65
Franzen E T, Ch Engr Dsgn & Cons (Ret), MP RR, 83 Webster Woods, Webster Groves, MO 63119 02-06-57
Fredrick E R, Engr B&B (Ret), FEC RY, 304 St George St, St Augustine, FL 32084 03-23-65

Gableman P D, Mgr Envrn Engr (Ret), DM&IR RY, 201 E 8th St, Superior, WI 54880 09-14-66
Gardner W E, Steel Brdg Supv (Ret), MKT RR, 2705 W Washington, Denison, TX 75020 09-26-67
German J G, VP-Engrg (Ret), MP RR, 19 Holloway Dr, Lake Saint Louis, MO 63367 10-11-67
Gipson C G, Gen Frmn B&B/WS (Ret), AT&SF RY, 3955 W Cactus Wren Dr, Phoenix, AZ 85021 01-01-57
Goforth J A, Ch Engr (Ret), Clinchfield RR, PO Box 108, Erwin, TN 37650 01-01-54
Golem G G, Asst Engr-Br Dept (Ret), IC RR, 715 Vinewood, Willow Springs, IL 60480 04-27-64
Gould D C, Asst Strl Engr (Ret), UP RR, 2123 S 109th St, Omaha, NE 68144 10-10-67
Grecco E F, Proj Mgr (Ret), B&LE RR, 201 Woodbury Dr, Butler, PA 16001 01-06-69
Gunkle W J, Sr Str Insp (Ret), Conrail, 107 Fairhill Rd, Morton, PA 19070 01-10-66

Haines W W, B&B Supv (Ret), UP RR, 1911 SW 42nd St, Pendleton, OR 97801 09-27-67
Hamilton W A, Br Engr (Ret), AT&SF RY, 3007 Atwood, Topeka, KS 66614 09-13-65
Hawley I H, Ch Engr (Ret), C&IM RY, 40 Friars Lane, Springfield, IL 62704 12-02-57
Hellweg R D, Reg Engr (Ret), Amtrak, 1301 N Eastholme, Bloomington, IL 61701 02-25-47
Hodgkins E W, Exec Dir (Ret), AREA, 3576 E 7800 S, Salt Lake City, UT 84121 10-15-58
Hogel E C, B&B Supv (Ret), UP RR, 2600 West E St, North Platte, NE 69101 05-06-58
Hoppell V E, B&B Supv (Ret), UP RR, 35160 SE Skoggan Rd, Sandy, OR 97055 11-17-67
Howard J G, Gen B&B Supv (Ret), WP RR, 1624-36th St, Sacramento, CA 95816 10-05-53
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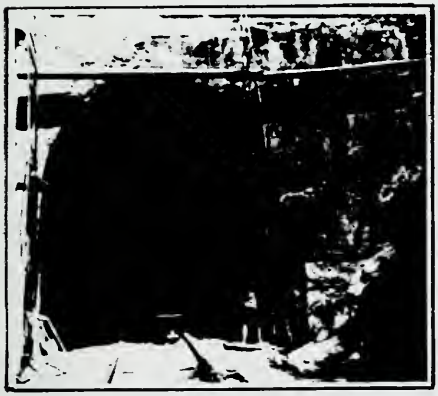

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Hunter A L, Supv Strs (Ret), B&LE RR, 8 Park Ave, Greenville, PA 16125 10-05-60
Hutcheson T B, Asst VP/Ch Engr (Ret), Seaboard, 5621 Cary St Rd #4, Richmond, VA 23226 09-05-61
Hyma W R, Br Eng Sys (Ret), AT&SF RY, 18 Bertoldo Rd, Park Forest, IL 60466-1847 01-01-69

Iler F C, Gen Frmn B&B/WS (Ret), AT&SF RY, 610 Williamson Ave, Winslow, AZ 86047 12-14-65
Irby C W, Gen Frmn B&B/WS (Ret), AT&SF RY, RR 2 Box 2746, Belton, TX 76513 09-26-67

Jackman C E, Trans Cnslt (Ret), 15713 Gardenside Ln, Tampa, FL 33624-1819 10-15-58
Jackson T E, Gen B&B Supv (Ret), SP Trans Co, 109 Karen Dr, Benicia, CA 94510 01-01-40
Jenkins H W, Ch Engr (Ret), NYNH&H RR, PO Box 447, Green Valley, AZ 85614 01-13-40
Johnson H T, Matl & Equip Engr (Ret), Penn Central, 52 Helena St, E Brunswick, NJ 08816 10-05-60

Kendall J T, Supv Strs (Ret), Penn Central, 312 Cypress St, Montoursville, PA 17754 07-15-49
King L E, Reg B&B Mgr (Ret), SP Trans Co, 4100 Spring Valley Rd, Rocklin, CA 95677-1537 06-14-66

Langham L D, Div Engr (Ret), AT&SF RY, Rt 1 Box 110-A, De Kalb, TX 75559 12-08-64
Laurick M J, Proj Engr (Ret), Conrail, 1693 Sandalwood Pl, Columbus, OH 43229 12-08-52
Lawton R R, Asst Chf Eng Stf (Ret), C&NW Trans Co, 1334 Naperville Rd, Wheaton, IL 60187 09-13-65
Layer J P, Sr Engr (Ret), R W Consultants Inc, 5743 Lynn Dr, Franklin, OH 45005-5111 09-02-66
Leach L J, B&B Supv (Ret), UP RR, PO Box 298, Watervilles, KS 66548 09-26-67
Lelevich L E, Mgr Bdgts (Ret), UP RR, 7401 Alix Pkwy, Sacramento, CA 95823-3003 02-09-67
Linn G A, Div Engr (Ret), C&NW Trans Co, PO Box 141, Thedford, NE 69166-0141 10-07-40
Long W R, Mtl Plnr (Ret), SP Trans Co, 2320 S Jackson St, Albany, OR 97321 12-09-63
Lowry J M, Asst Dist Engr (Ret), SP Trans Co, 5242 Jackwood St, Houston, TX 77096 05-03-50
Lund C V, Asst To VP/CE (Ret), CMSP&P, 344 Scott Ave, Glen Ellyn, IL 60137 02-25-47

Mabry D B, VP-Sales (Ret), Moss-American Inc, 420 Edgewood Dr, St Louis, MO 63105 10-13-48
Makarowski S, Bldg Mgr (Ret), CN RY, 5808--94th Ave, Edmonton,ALB,Canada,T6B 0X8 09-16-64
Martin J W, Mast Carp (Ret), Seaboard, 4656 E Glen Ridge Crcl, Winston, GA 30187 09-14-53
Martyn G W, Mgr Fac & Cvl Eng (Ret), EJ&E RY, 510 Peale St, Joliet, IL 60433 07-22-59
Mascorro F F, Gen Frmn (Ret), AT&SF RY, 6213 Warrington Pl, Ft Worth, TX 76112 01-28-72
Mathias H O, Mgr Cntrs & Admn (Ret), IHB RR, 320 S 8th Ave, LaGrange, IL 60525 09-28-59
McCoy D E, B&B Supv (Ret), BN RR, 8378 Cherokee, Denver, CO 80221 03-23-65
McMaster R C, Mgr Fac & Strs (Ret), B&LE RR, 318 Clinton St, Greenville, PA 16125 01-10-66
Messman D V, Asst To CE (Ret), Southern RY, 3329 Stonecrest Ct, Atlanta, GA 30341 03-14-55
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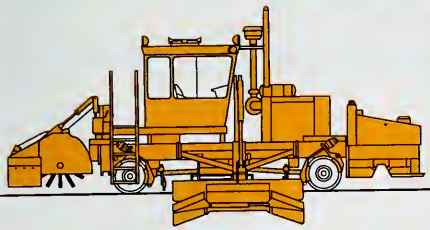

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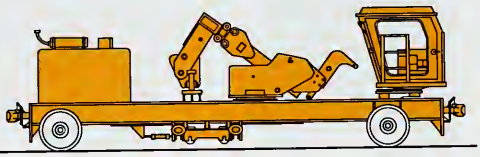

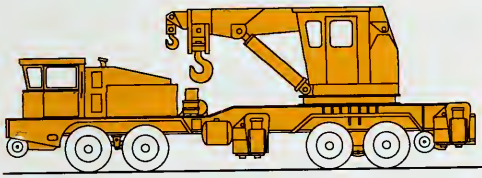

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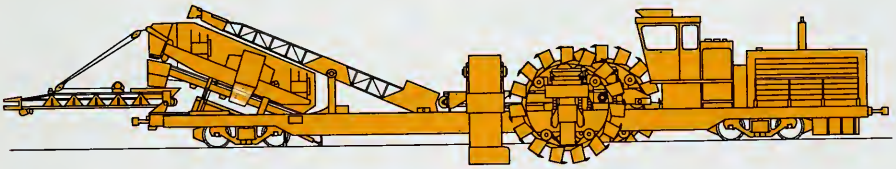

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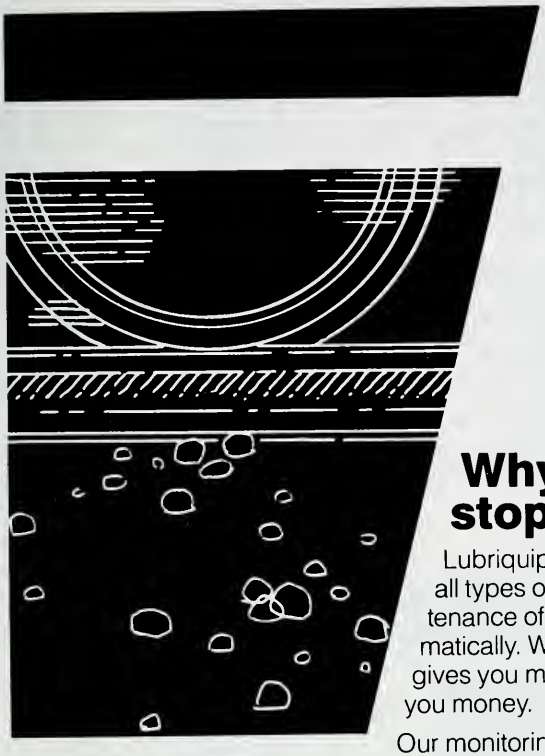

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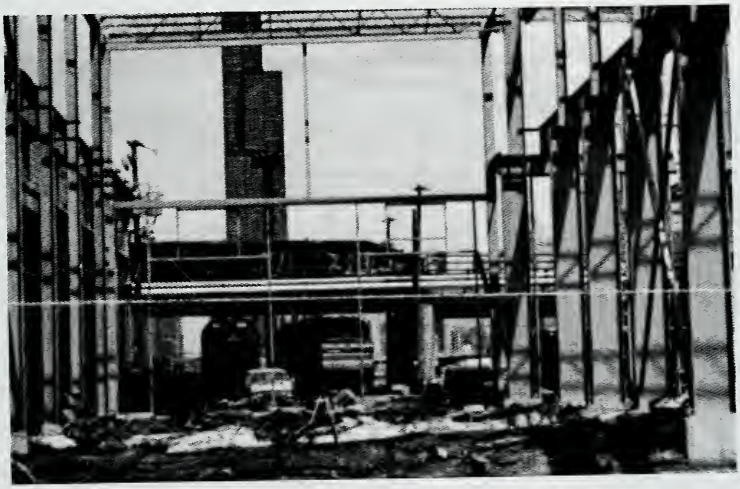

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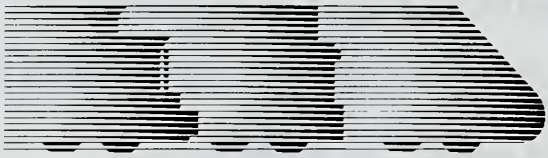

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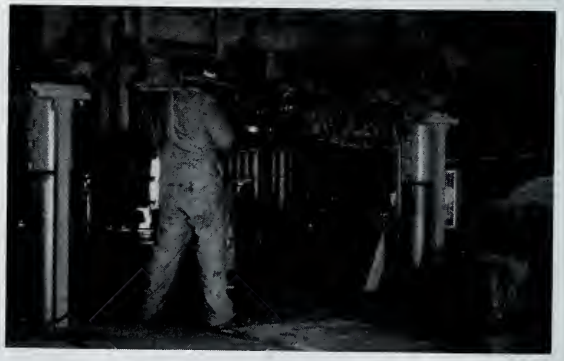

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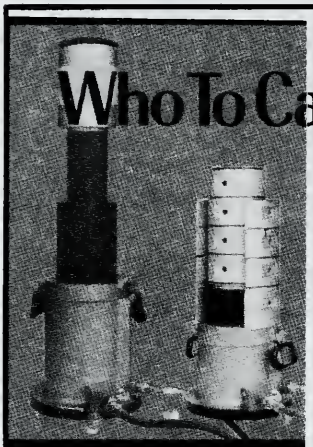

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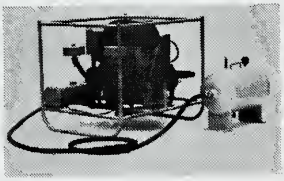

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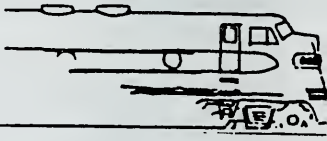

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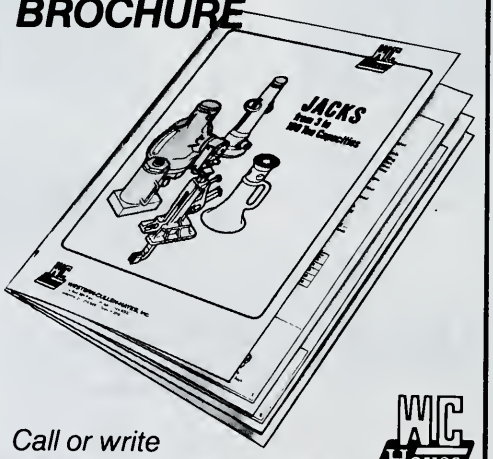

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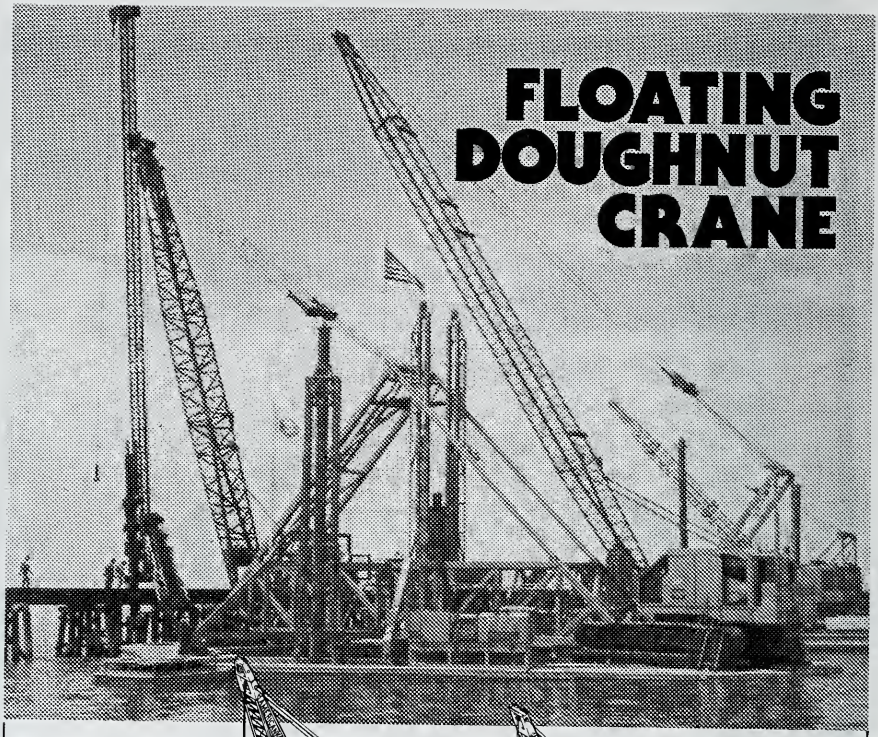

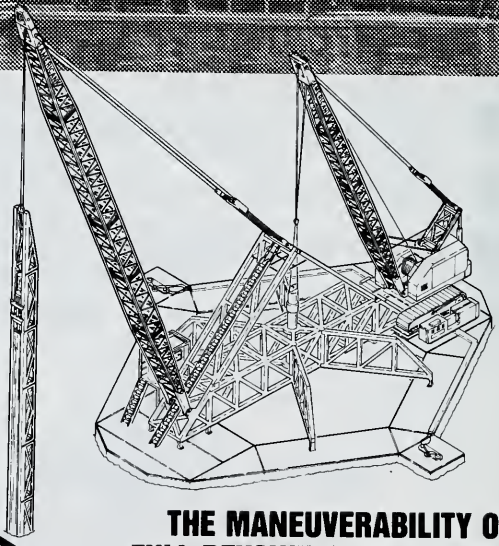

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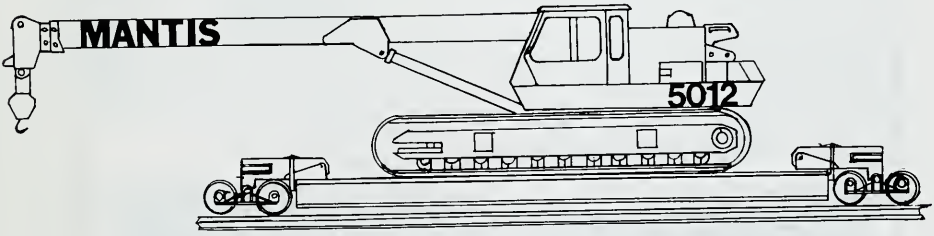

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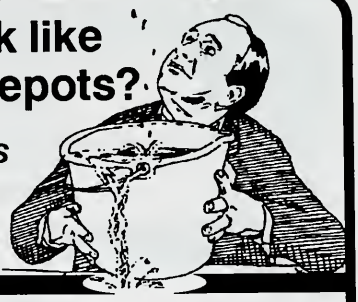

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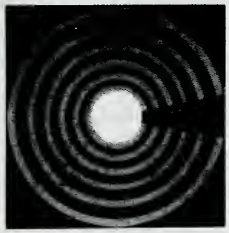

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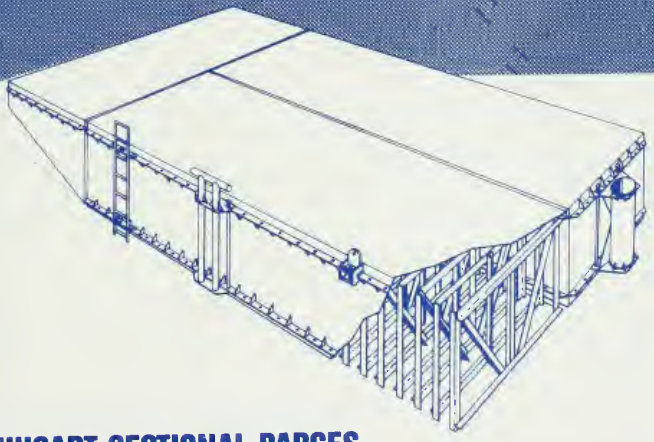

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